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CONFIDENTIAL

SECOND

PROGRESS REPORT

OF

FC

THE FIRESTONE TIRE & RUBBER COMPANY

ON

RECOILLESS RIFLES, ACCESSORIES AND AMMUNITION

UNDER

Contract No. DA-33-019-ORD-2037

Ordnance Project No. TS4-4020

Department of Army Project No. 5802-09-010 4018

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COPY No. 52

THE FIRESTONE TIRE & RUBBER COMPANY

Defense Research Division

Akron, Ohio

MARCH 1956

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SECOND

PROGRESS REPORT

OF

THE FIRESTONE TIRE & RUBBER CO.

ON

RECOILLESS RIFLES, ACCESSORIES AND AMMUNITION

Contract No.
DA-33-019-ORD-2037

ORDNANCE PROJECT Nos. TS4-4020
TS4-4018

THE FIRESTONE TIRE & RUBBER CO.
Defense Research Division
Akron, Ohio

MARCH, 1956

INDEX

SUMMARY
OF
WORK ACCOMPLISHED TO START OF CURRENT REPORT PERIOD

This report constitutes the second monthly progress report of The Firestone Tire & Rubber Company, Defense Research Division, on Contract DA-33-019-ORD-2037. It was explained in the First Progress Report for February, 1956, that this contract covers activities in two general fields: (1) those pertaining to a 90mm, Light Weight, Shoulder-Fired Rifle and Ammunition, known as the PAT System, and (2) those activities carried over from previous Contract DA-33-019-ORD-1202 pertaining to the Battalion Anti-Tank Weapon and Ammunition, known as the BAT System.

This Summary presents a brief status report of work done on each of these two phases under Contract DA-33-019-ORD-2037 to the beginning of this current report period.

PAT AMMUNITION AND WEAPON - The following statements summarize the previous activities on this phase of the total contract.

1. Drawings of T249E8 cartridge assembly were revised for ease of manufacture and were designated T249E8 modification 1 (Mod. 1).

2. Two modifications of the carriage design have been made and designated T249E8 Mod. 2A and T249E8 Mod. 2B.

3. Procurement was started for:

100 T249E8 Mod. 1 Shell
1000 Primer Assemblies
150 Propellant Containers
25 T249E8 Mod. 2A Shell
25 T249E8 Mod. 2B Shell
Extrusions for 1000 fin assemblies.
Forgings for 1000 projectile bodies.

4. Forgings for one test rifle and one prototype rifle were received from Frankford Arsenal.

5. Tests were conducted to determine the permissible thickness of Mylar for the central tube of the cartridge container.

6. A program for penetration studies with the PAT round was planned and presented in the First Progress Report.

BAT WEAPON AND AMMUNITION - The following statements present the status of the various portions of the BAT assignment.

Weapon Systems

The 90mm T215 No. 3 rifle was proof accepted.

Folding Fin Ammunition

Spin and obturation tests were conducted with the 106mm T119 E11 (M344) projectile and the 90mm T335 projectile, using nylon obturating bands.

Fixed Fin Ammunition

An accuracy program with ten, 90mm T334E2F projectiles at 1000 yards, was conducted. The Probable Errors of dispersion were .45 mil vertically and .41 mil horizontally.

Spin tests with T334S4 test slugs equipped with type No. 8 nylon obturators showed an average spin rate of 20.5 rps.

A program has been prepared for further accuracy testing of the 106mm T171 projectile.

Penetration Studies

Rotary-extruded liners with 90 degree angular distortion were tested in 105mm test bodies for spin compensation. The optimum spin rate was 20 rps.

Fuzes

Tests of the T267E14 fuze gave unsatisfactory functioning. No further work is scheduled.

Terminal Ballistic Effectiveness

A future program was proposed and presented in the First Progress Report on this contract.

ABSTRACT OF CURRENT PROGRESS REPORT

The activities of The Firestone Tire & Rubber Company, Defense Research Division, on Contract DA-33-019-ORD-2037 during this report period have been concerned with (1) the PAT ammunition and rifle, and (2) the BAT weapon and ammunition.

PAT AMMUNITION AND WEAPONS - The activities under this phase of the contract have pertained to (1) preparation of drawings, revisions of drawings for manufacturing ease; redesign of certain components, and (2) procurement, manufacture and assembly of components and preparations for tests.

Drawings are presented of the primer assembly, rounds containing T249-E8 Mod. 1, Mod. 2A and Mod. 2B projectiles; Metal Parts & Live Loading drawings of T249E8 Mod. 1, Mod. 2A, and Mod. 2B; details and assembly drawing of a shipping container.

Photographs are presented illustrating the T249E8 Mod. 1 cartridge, the test cartridge and the test rifle.

Components for cartridges, projectiles and rifles for tests planned and programmed in the First Progress Report are in various stages of manufacture and procurement. The status of each of these components is given in this report.

BAT WEAPONS AND AMMUNITION - The activities have been concerned during this report period with (1) test firing the 106mm T119E16 folding fin projectile, (2) test firing the 90mm T335 folding fin projectile and (3) penetration studies to investigate the effect of ogive and nose assemblies on penetration.

T119 Projectile - Fifteen T119E16 projectiles have been fired in a test to develop an improved nylon obturator. The largest band diameter tested (4.248 in.) gave good obturation and an acceptable muzzle spin of approximately 15 rps. The results indicate that even larger band diameters may be used.

T335 Projectile - Nine 90mm T335E11 projectiles have been fired at a 2000-yard target. Accuracy testing at this range has been deferred until weather is more favorable. A future program is given.

Penetration Studies - PAT Projects - Tests were conducted to determine the effect of ogive ALX-178-6 and nose assembly ALX-178 on penetration. The three items compared were: (1) test assembly DRC506 and nose rings DRB-23-1056, (2) test assembly DRC506 with ogive DRA-29-1842, and (3) test assembly DRC506 with ogive DRA-29-1842 and nose assembly LX 178-8, -9 and -15. The ogive alone produced only slight reduction in penetration. The ogive and nose assembly combined produce a reduction of 1.6 in. The nose assembly alone apparently produces 1.2 in. of reduction in

penetration. Spin rates of 18 rps at 900 fps reduces penetration by approximately 3/4 in. As a result of tests it is estimated that the test assembly should produce about 12.5 in. penetration into homogeneous armor.

BAT Projects - Thirty 120mm test assemblies were manufactured and sent to Ravenna Arsenal for Comp B loading.

A future program is presented.

Terminal Ballistic Effectiveness - A future program is reported.

PAT AMMUNITION AND WEAPON

PAT AMMUNITION

Cartridges

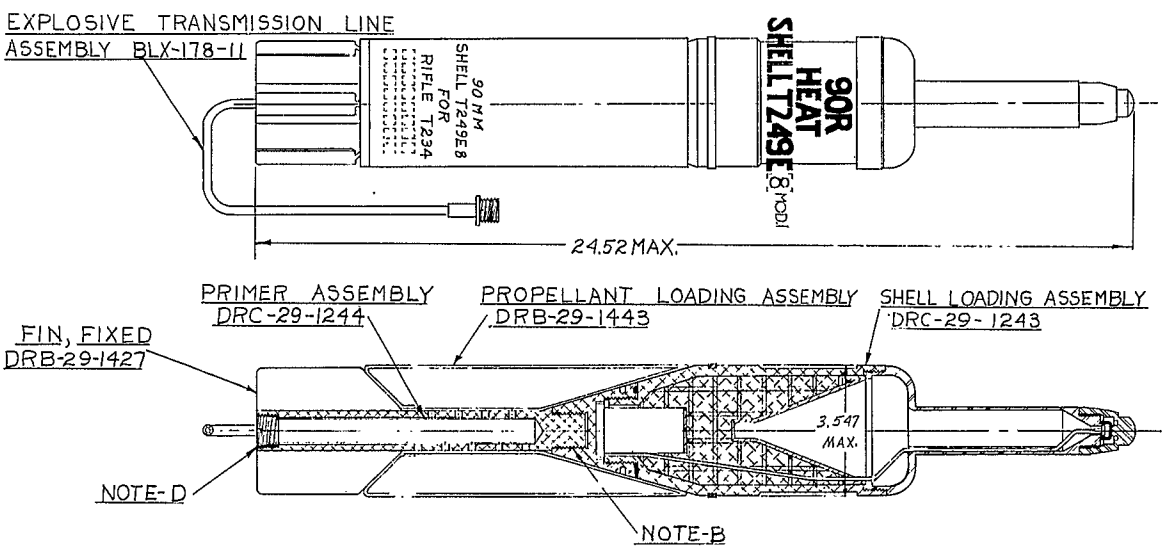
Cartridge assembly drawings for rounds containing the 90mm T249E8 Mod 1, Mod 2A and Mod 2B projectiles are shown in Figs. 1, 2 and 3, respectively. A picture of the T249E8 Mod 1 cartridge is shown in Fig. 4. The test cartridge is pictured in Fig. 5.

Primer

Eleven hundred primer assemblies (DRC 29-1244), less igniter charges, have been received. Two hundred assemblies have been shipped to the Ravenna Arsenal for loading. The 150 lbs. of Grade A1 black powder requisitioned from Frankford Arsenal for use as igniter charges have not arrived, but five pounds of this grade of black powder have been obtained locally for loading primers.

One hundred S-78 electric squibs to initiate the primer charges for interim testing have been procured from duPont deNemours, Wilmington, Delaware. The dimensions and characteristics of the S-78 squib are shown in Table I.

The squib will be placed one third of the distance forward in the primer. The lead wires will be threaded through the diaphragm of the primer end plug and through the connector (DRA29-1854) shown in Fig. 6. All firings currently planned at the Erie Ordnance Depot will employ this interim ignition system.



NOTES:

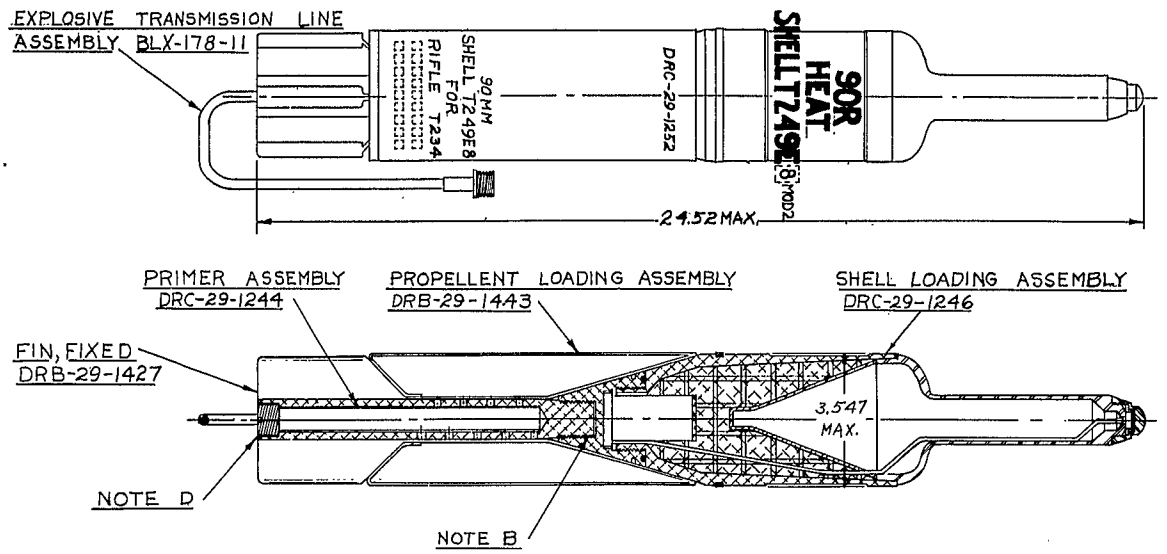
A. RETOUCH EXTERIOR SURFACES WHERE PREVIOUS COATINGS HAVE BEEN DAMAGED.

B. COAT FORWARD THREADS OF FIN, FIXED, WITH CEMENT, PETTMAN, TYPE A, SPEC. JAN-C-99. WITH PROPELLANT LOADING ASSEMBLY IN POSITION SECURE FIN TO SHELL LOADING ASSEMBLY, WHILE CEMENT IS WET, WITH 140 IN-LBS MINIMUM TORQUE.

C. INSERT PRIMER ASSEMBLY INTO BORE OF FIN WITH DIAPHRAGM END TO REAR.

D. COAT MATING THREADS OF EXPLOSIVE TRANSMISSION LINE ASSEMBLY WITH PETTMAN CEMENT AND SECURE TO FIN, WHILE CEMENT IS WET, WITH 120 IN-LBS MINIMUM TORQUE.

Fig. 1. 90 mm., T249E8 Mod. 1 Projectile.
Firestone Dwg. No. DRC-29-1253-1.



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A. RETOUCH EXTERIOR SURFACES WHERE PREVIOUS COATINGS HAVE BEEN DAMAGED.

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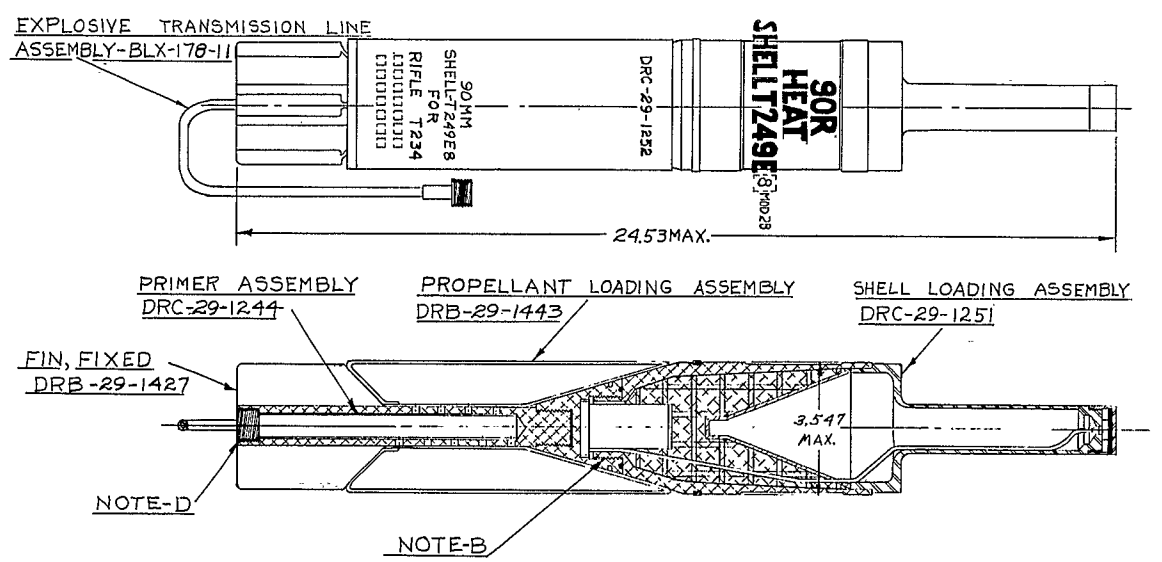
C. INSERT PRIMER ASSEMBLY INTO BORE OF FIN WITH DIAPHRAGM END TO THE REAR.

D. COAT MATING THREADS OF EXPLOSIVE TRANSMISSION LINE ASSEMBLY WITH PETTMAN CEMENT AND SECURE TO FIN, WHILE CEMENT IS WET, WITH 120 IN-LBS MINIMUM TORQUE.

Fig. 2. 90 mm., T249E8 Mod. 2A Projectile.
Firestone Dwg. No. DRC-29-1254-1.



NOTES:

A. RETOUCH EXTERIOR SURFACES WHERE PREVIOUS COATING HAVE BEEN DAMAGED.

B. COAT FORWARD THREADS OF FIN, FIXED, WITH CEMENT, PETTMAN, TYPE A, SPEC. JAN-C-99. WITH PROPELLANT LOADING ASSEMBLY IN POSITION, SECURE FIN TO SHELL LOADING ASSEMBLY, WHILE CEMENT IS WET, WITH 140 IN-LBS MINIMUM TORQUE.

C. INSERT PRIMER ASSEMBLY INTO BORE OF FIN WITH DIAPHRAGM END TO THE REAR.

D. COAT MATING THREADS OF EXPLOSIVE TRANSMISSION LINE ASSEMBLY WITH PETTMAN CEMENT AND SECURE TO FIN, WHILE CEMENT IS WET, WITH 120 IN-LBS MINIMUM TORQUE.

Fig. 3. 90 mm., T249E8 Mod. 2B Projectile.
Firestone Dwg. No. DRC-29-1255-1.

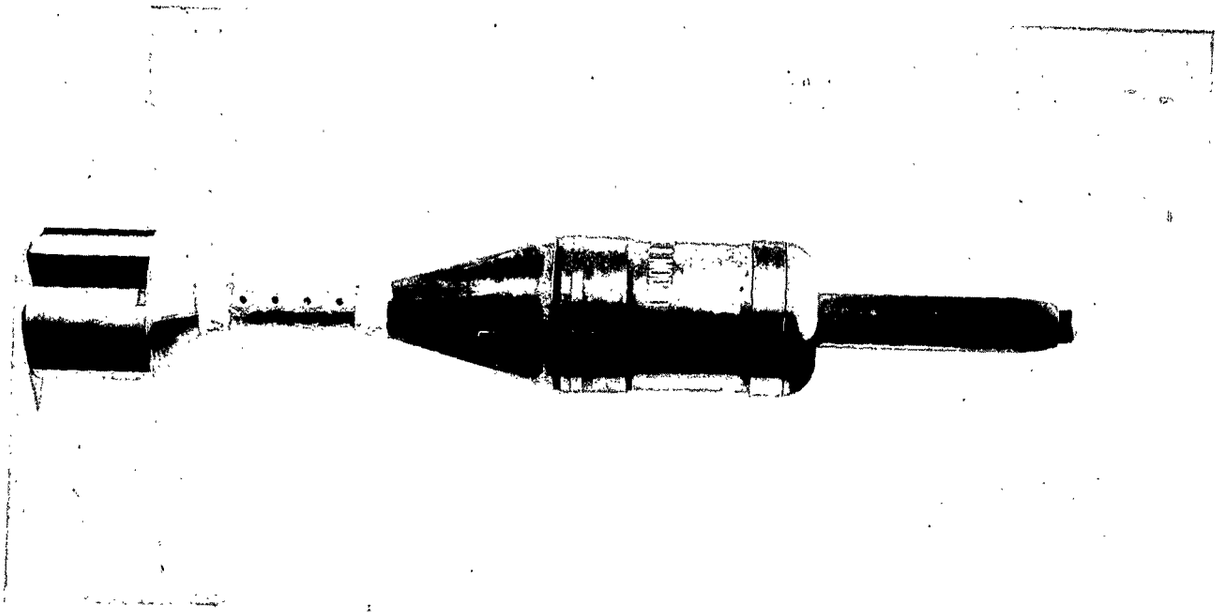


Fig. 4. T249E8 Mod. 1 Cartridge.

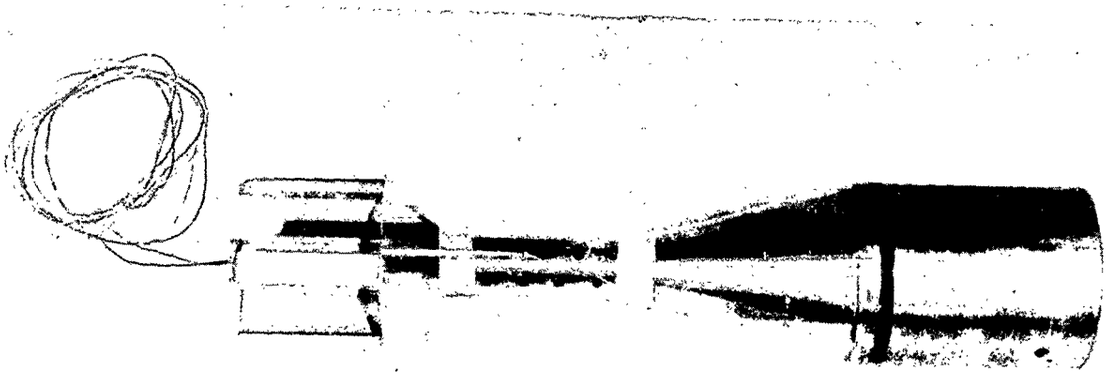


Fig. 5. Test Cartridge.

Table I
Dimensions and Characteristics
S-78E Electric Squibs

Shape	Cylindrical
Outside Diameter	0.269 + .002 In.
Length	1.6875 In.
Lead Wire Length	4 Ft.
Wire Size	0.0375 In.
Bridge Wire	Nicrome (.80-.20), 0.125 In. Long Bridge. 173 to 183 Ohms / Mil Ft. at 68°F.
Explosive Mixture	DuPont Ignition Mixture 50 - 25 - 25 (15 grains)
Firing Current	0.300 amps minimum
Resistance of System	2.45 ohms + 0.25 ohms

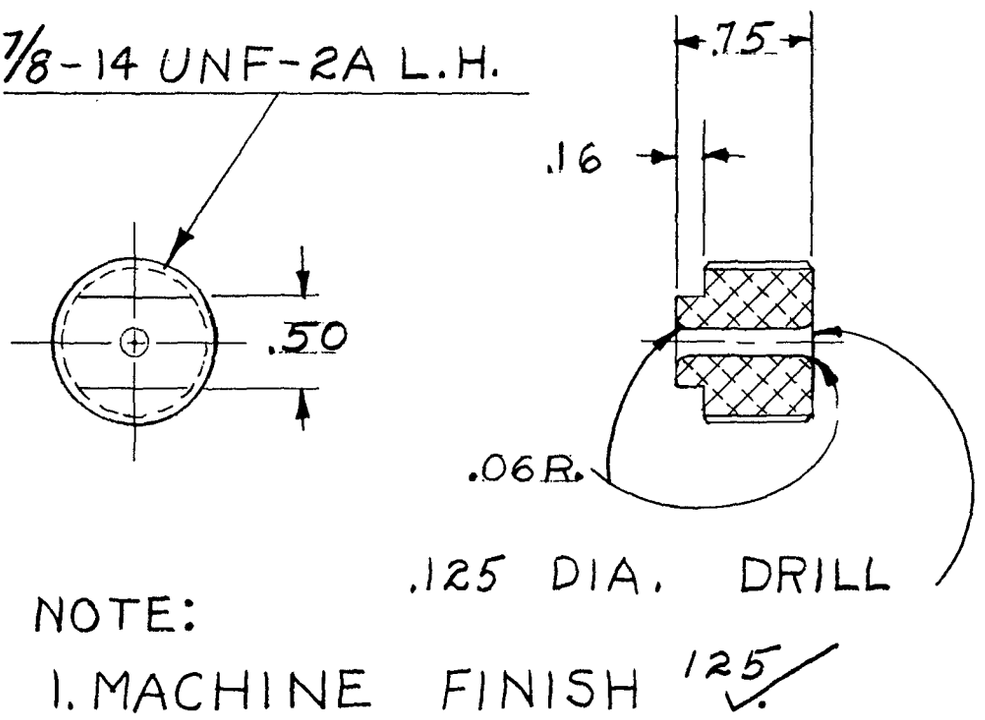


Fig. 6. Connector.
Firestone Dwg. No. DRA-29-1854.

Projectile Studies

T249E8 MOD PROJECTILES

Dummy base elements, which represent the base element of the T199E1 fuze requisitioned from Frankford Arsenal, have not arrived. One hundred and twenty-five dummy base elements have been ordered locally. Partial delivery has been accepted and the remainder will be delivered early in April.

Five of the 25 T249E8 Mod 1 Projectiles originally scheduled for live loading at Ravenna Arsenal, will be inert loaded for fuze evaluation tests to be conducted at the Erie Ordnance Depot. These projectiles will be assembled with battery units (75-2-502F2), tetryl pellets and M509 fuze base elements. The remaining 20 projectiles will be live loaded at Ravenna Arsenal as soon as T199E1 fuze base elements are received from Picatinny Arsenal. Inspection data for 20 cones which will be assembled into these projectiles are reported in Table II.

Thirty-one of the 75-2-502F2 battery units, which were available at Firestone, have been tested during the current report period. Three tests: electrical resistance, activity and impact, have been performed on each unit and the data are reported in Table III. Twenty-five of these units will be used in the above mentioned projectiles.

Seventy-five T249E8 Mod 1 projectiles have been inert loaded and will be shipped to Ravenna Arsenal for cartridge assembling and packaging.

Metal parts assembly drawings and live loading drawings for the T249E8 Mod 1, Mod 2A and M2B projectiles are presented in Figs. 7 through 12. Spikes for the Mod 2A projectiles were unacceptable dimensionally and all but five have been returned to the manufacturer. Five Mod 2A projectiles will be employed in a penetration program discussed in the Penetration Study of this report. Spikes for Mod 2B projectiles have not been received.

PROOF PROJECTILES

Twenty-six proof projectiles (DRC 29-1239-1) have been manufactured and have been shipped to Erie Ordnance Depot. Propellant loading and primer insertion for the test cartridges will be performed there. These assemblies will be employed in rifle proof testing and recoil balancing programs.

Propellant

Two hundred pounds of propellant for the T234 Recoilless Rifle have been requisitioned from Frankford Arsenal. The propellant type and web thickness will be specified by the Pitman-Dunn Laboratories.

Table II
Summary Inspection Data
20 DRB29-1429 Cones

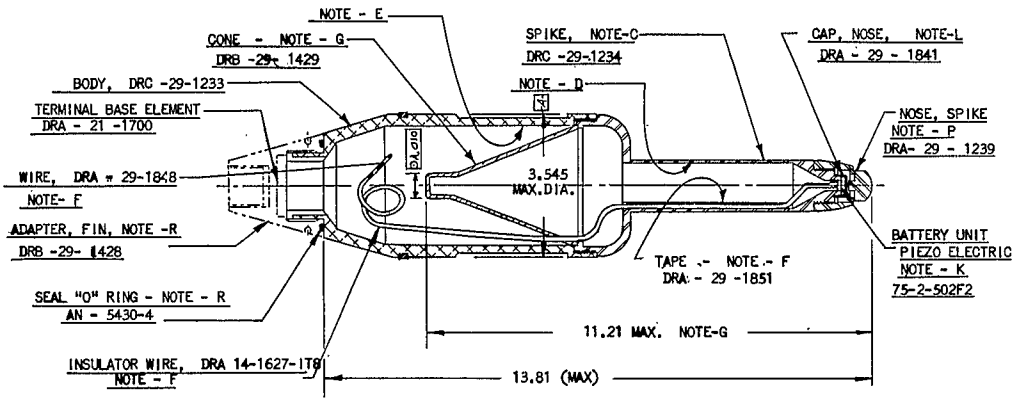
	Wall Thickness (in.)	Max. Wall Thickness Variation (in.)		Max. Wall Waviness (in.)		Concentricity - T.I.R. (in.)			Cone Tip in Assembly
		Transverse	Longitud.	O. D.	I. D.	Base Datum	Apex Datum	Spitback Tube in Ass'y.	
Specification	Max. .085 Min. .080	.002	.006	.006	.006	.003	.003	.003	Max. .015
Maximum	.089	.006	.007	.006	.001	.009	.008	.011	.010
Minimum	.079	.001	.002	.001	.001	.002	.001	.002	.003
Average	.0835	.0030	.0034	.0036	.001	.0044	.0048	.0061	.0069
Std. Dev.	.0011	.0022	.0014	.0012	----	.0020	.0020	.0022	.0020

Note:
Summary inspection data for cone numbers: 16, 17, 20, 24, 29, 36, 37, 38, 47, 49, 51, 55, 58, 64, 68, 72, 76, 81, 82, 91.

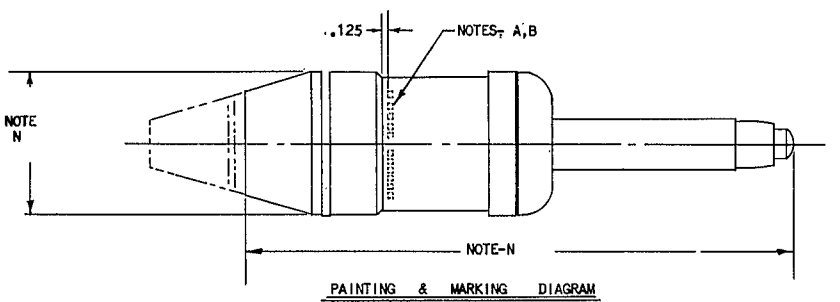
Table III
Test Data
For 31 75-2-502F2 Battery Units

Lucky No.	Decibels At 200K.Cycles	Decibels x_1	K. Cycles x_1	Decibels x_2	K. Cycles x_2	Voltage For .0173 Lb.-Sec. Impact (volts)
1 ●	11.5	12.0	221	11.4	228	Cracked
2	11.5	13.5	299	9.0	309	6.96
3	11.3	13.0	286	9.0	292	4.25
4	11.5	12.5	241	12.0	248	3.23
5	11.5	12.25	229	12.0	235	5.78
6	11.1	12.3	245	11.5	255	4.42
7	11.2	12.2	232	11.3	237	8.67
8	12.0	13.5	277	11.6	282	3.74
9	11.4	12.7	246	11.0	251	4.08
10	11.2	13.1	276	10.5	288	3.06
11	11.6	13.5	275	9.5	281	3.40
12	11.0	12.3	241	11.0	247	6.11
13	11.2	13.1	277	10.0	282	3.06
14 ●	11.2		No Dip			4.08
15	11.6	13.5	281	8.4	284	4.76
16	11.3	13.5	286	11.7	290	
		13.0 *	294	8.8	297	2.89
17	11.4	13.4	282	11.0	288	2.89
18	11.4	12.6	255	11.1	260	5.95
19 ●	11.3		No Dip			4.75
20	11.4	13.0	298	10.7	305	3.74
21	11.6	13.1 *	270	12.3	279	
		12.9	285	11.9	288	4.42
22	11.4	12.4 *	236	11.7	241	
		12.5	256	12.0	261	5.10
23	11.3	13.2	276	9.4	281	7.65
24	11.5	13.6 *	277	9.7	286	
		12.8	292	10.8	294	3.23
25	11.5	13.1	265	10.8	277	3.06
26	11.3	12.9	270	11.6	283	2.55
27	11.5	12.6	237	11.0	239	3.57
28	11.5	12.4	240	11.1	244	4.93
29	11.1	13.8	287	6.6	293	4.25
30	11.3	13.4	285	9.1	292	3.06
31	11.5	13.3	287	10.5	295	2.72

Notes:
● Rejected
* Double Dip
All units had measured resistance over 20×10^6 ohms.



METAL PARTS ASSEMBLY



PAINTING & MARKING DIAGRAM

NOTES:

A. STAMP "90MM T249E8 MOD. 1" AND PROJECTILE SERIAL NUMBER.

B. LETTERS AND FIGURES TO BE .125 HIGH AND .01 DEEP.

C. PREPARE OR CLEAN ALL SURFACES OF SPIKE IN ACCORDANCE WITH GRADE 1 APEC. PA-PD-191 BEFORE PAINTING.

D. COAT INTERIOR SURFACE OF SPIKE, EXCEPT CONE SEAT, WITH GREEN NO.3412 ENAMEL BEFORE ASSEMBLY WITH BODY.

E. COAT INTERIOR SURFACE OF BODY, EXCEPT THREADS, WITH ACID-PROOF BLACK PAINT, TYPE 1 OR 11, BEFORE ASSEMBLY.

F. THREAD FUZE WIRE THRU INSULATOR AND CEMENT TO SPIKE USING TAPE AND RUBBER CEMENT, TYPE 3, SPEC MIL-C-5092.

G. APPLY CEMENT, TYPE 3, TO CONE SEAT OF SPIKE, INSERT INSULATOR AND WIRE IN HOLE IN CONE, AND PRESS CONE INTO SPIKE.

H. APPLY CEMENT, TYPE 3, TO JUNCTION OF INSULATOR AND CONE.

K. CRIMP BATTERY UNIT TO FUZE WIRE AND SEAT BATTERY UNIT IN POSITION ON SPIKE.

L. PLACE CAP, NOSE, OVER BATTERY UNIT AND CRIMP 360 TO SPIKE.

M. COAT REAR THREADS OF SPIKE WITH PETTMAN CEMENT, TYPE A, SPEC. JAN-C-99, AND SECURE TO BODY WHILE WET WITH 235 IN-LBS MINIMUM TORQUE.

N. COAT EXTERIOR SURFACES OF METAL PARTS EXCEPT THREADS WITH GREEN NO. 3412 ENAMEL, SPEC. MIL-E-10687.

P. SECURE NOSE, SPIKE, TO SPIKE HAND TIGHT. DO NOT CEMENT THREADS.

R. THESE PARTS TO BE SHIPPED SEPARATELY BY MANUFACTURER.

Fig. 7. Shell, HEAT, 90 mm., T249E8 Mod. 1 Metal Parts Assembly.
Firestone Dwg. No. DRC-29-1242.

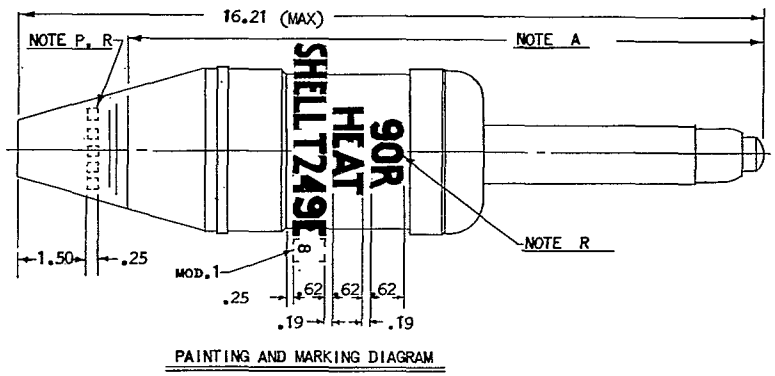
NOTES:

A. RETOUCH EXTERIOR SURFACES OF SHELL WHERE PREVIOUS COATING HAS BEEN DAMAGED WITH GREEN ENAMEL NO. 3412.
B. GUIDE WIRE AND WIRE INSULATOR THRU SLOT IN REAR OF BODY AND INSERT POURING RISER.
C. POUR COMP. B.
D. REMOVE POURING RISER AFTER COMP. B HAS HARDENED.

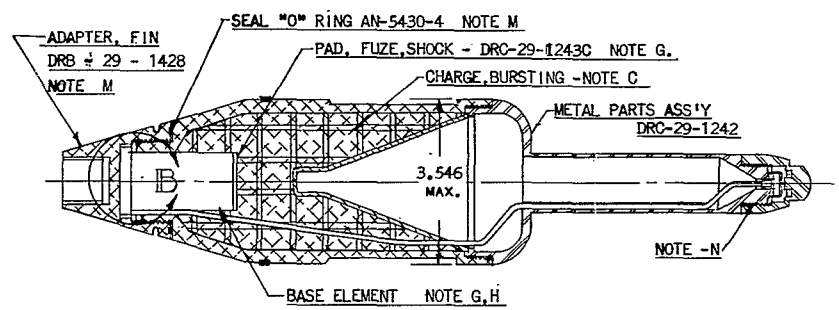
E. FACE OFF COMP B. TO DEPTH SHOWN.
F. X-RAY ASSEMBLY TO DETECT POSSIBLE DETRIMENTAL CAVITATION IN COMP. B. CAST.
G. PLACE FUZE WIRE AND WIRE INSULATOR IN SLOT OF BODY. PLACE BASE ELEMENT SHOCK PAD DRC-29-1243 C IN BASE ELEMENT CAVITY. THE BASE ELEMENT INSULATION RESISTANCE MUST BE MEASURED AND RECORDED. PLACE BASE ELEMENT IN CAVITY.
H. CUT WIRE AND INSULATOR 1.5 INCHES BEYOND BASE ELEMENT. BARE WIRE A DISTANCE OF 3/16 INCH FROM END. CRIMP SOLDERLESS TERMINAL TO BATED SECTION. REMOVE POST. ATTACH TERMINAL TO POST AND SCREW POST TO BASE ELEMENT.

K. PERFORM FINAL ELECTRICAL TESTS.
L. PLACE INSULATOR, FUZE, DRC-29-1243 B ON BASE ELEMENT.
M. COAT REAR THREADS OF BODY WITH CEMENT, PETTMAN, TYPE A, SPEC. JAN- C-99 AND SECURE FIN ADAPTER, WITH "O" RING IN POSITION, TO ASSEMBLY WITH 180 IN-LBS. MINIMUM TORQUE.

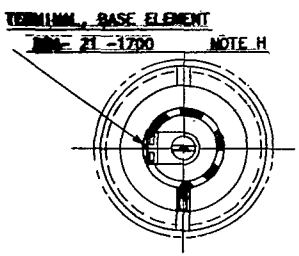
N. COAT SPIKE THREADS WITH PETTMAN CEMENT AND SECURE SPIKE NOSE TO SPIKE WHILE CEMENT IS WET WITH 144 IN-LBS. MINIMUM TORQUE.
P. INSERT LOT NUMBER, MONTH AND YEAR LOADED. REQUIRED ONLY WHEN SHELL IS NOT FURTHER IDENTIFIED BY SEGREGATION.
R. MARK WITH YELLOW NO. 3305 STENCIL INK.



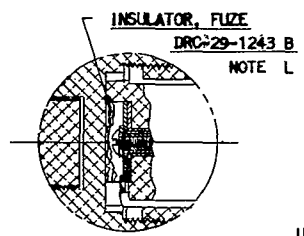
PAINTING AND MARKING DIAGRAM



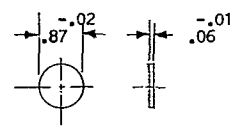
SHELL LOADING ASSEMBLY



END VIEW OF BASE ELEMENT, ADAPTER, FIN REMOVED TO SHOW DETAIL

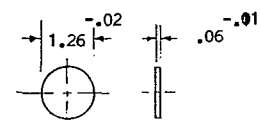


VIEW - B



INSULATOR, FUZE DRC - 29-1243 B
FELT, PRESS No 10½

DRC-29-1243 A



PAD, FUZE, SHOCK DRC-29-1243C
FELT, PRESSED NO. 10½

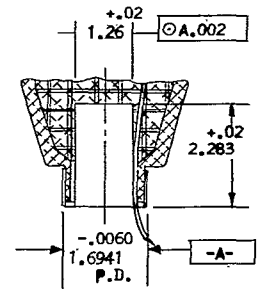


Fig. 8. Shell, HEAT, 90 mm., T249E8 Mod. 1 Loading Assembly.
Firestone Dwg. No. DRC-29-1243.

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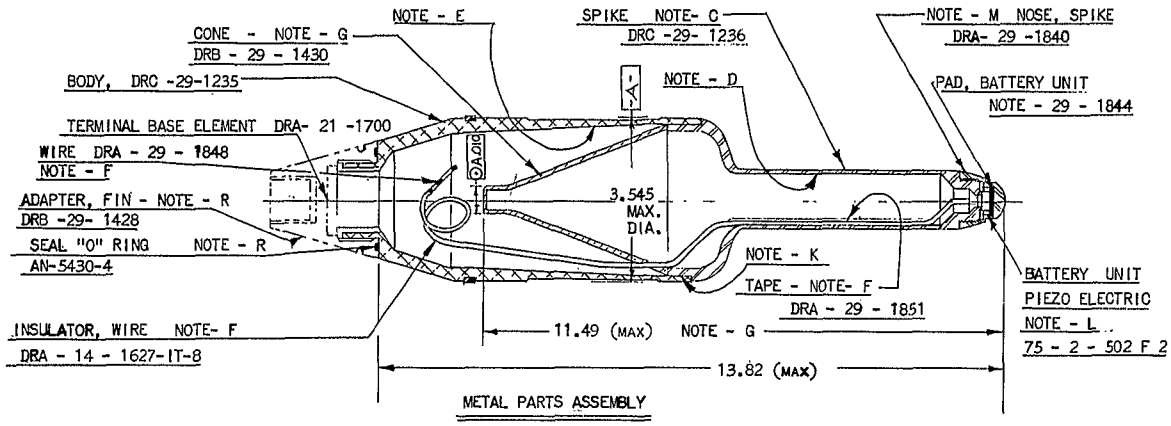
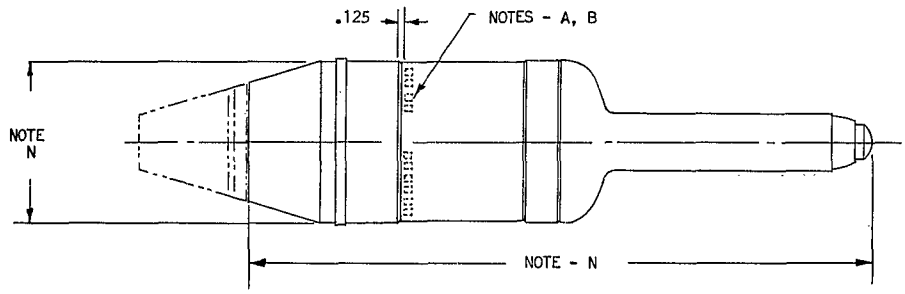


METAL PARTS ASSEMBLY



PAINTING AND MARKING DIAGRAM

NOTES:

A. STAMP " 90MM T249E8 MOD.2" AND PROJECTILE SERIAL NUMBER.

B. LETTERS AND FIGURES TO BE .125 HIGH AND .01 DEEP.

C. PREPARE OR CLEAN ALL SURFACES OF SPIKE IN ACCORDANCE WITH GRADE 1 SPEC. PA -PD -191 BEFORE PAINTING.

D. COAT INTERIOR SURFACE OF SPIKE, EXCEPT CONE SEAT, WITH GREEN NO.3412 ENAMEL BEFORE ASSEMBLY WITH BODY.

E. COAT INTERIOR SURFACE OF BODY, EXCEPT PART TO BE CEMENTED UNDER NOTE K, WITH ACID-PROOF BLACK PAINT, TYPE TOR11 BEFORE ASSEMBLY.

F. THREAD FUZE WIRE THRU INSULATOR AND CEMENT TO SPIKE USING TAPE AND RUBBER CEMENT, TYPE3, SPEC MIL-C-5092.

G. APPLY CEMENT, TYPE 3, TO CONE SEAT OF SPIKE, INSERT INSULATOR AND WIRE IN HOLE IN CONE, AND CRIMP FLANGE OF SPIKE OVER CONE-360 °

H. APPLY CEMENT, TYPE 3, TO JUNCTION OF INSULATOR AND CONE.

K. CEMENT SPIKE INTO BODY IN ACCORDANCE WITH PROCEDURE ON DRAWING DRA -10-1530.

L. CRIMP BATTERY UNIT TO FUZE WIRE AND SEAT BATTERY UNIT IN POSITION ON SPIKE.

M. PLACE PAD, BATTERY UNIT, ON BATTERY UNIT AND SECURE NOSE, SPIKE, TO SPIKE HAND TIGHT. DO NOT CEMENT THREADS.

N. COAT EXTERIOR SURFACES OF METAL PARTS EXCEPT THREADS WITH GREEN NO. 3412 ENAMEL, SPEC. MIL -E - 10687.

R. THESE PARTS TO BE SHIPPED SEPARATELY BY MANUFACTURER.

Fig. 9. Shell, HEAT, 90 mm., T249E8 Mod. 2 Metal Parts Assembly.
Firestone Dwg. No. DRC-29-1245-1.

NOTES:

A. RETOUCH EXTERIOR SURFACES OF SHELL WHERE PREVIOUS COATING HAS BEEN DAMAGED WITH GREEN ENAMEL NO. 3412.

B. GUIDE WIRE AND WIRE INSULATOR THRU SLOT IN REAR OF BODY AND INSERT POURING RISER.

C. POUR COMP. B.

D. REMOVE POURING RISER AFTER COMP. B.HAS HARDENED.

E. FACE OFF COMP. B TO DEPTH SHOWN.

F. X-RAY ASSEMBLY TO DETECT POSSIBLE DETRIMENTAL CAVITATION IN COMP. B CAST.

G. PLACE FUZE WIRE AND WIRE INSULATOR IN SLOT OF BODY. PLACE BASE ELEMENT SHOCK PAD DRC-29-1246 C IN BASE ELEMENT CAVITY. THE BASE ELEMENT INSULATION RESISTANCE MUST BE MEASURED AND RECORDED. PLACE BASE ELEMENT IN CAVITY.

H. CUT WIRE AND INSULATOR 1.5 INCHES BEYOND BASE ELEMENT. BARE WIRE A DISTANCE OF 3/16 INCH FROM END. CRIMP SOLDERLESS TERMINAL TO BARED SECTION. REMOVE POST. ATTACH TERMINAL TO POST AND SCREW POST TO BASE ELEMENT.

K. PERFORM FINAL ELECTRICAL TESTS.

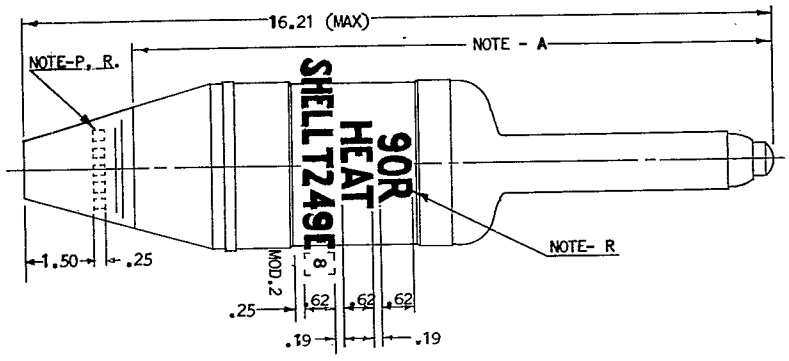
L. PLACE INSULATOR, FUZE, DRC-29-1246 B ON BASE.ELEMENT.

M. COAT REAR THREADS OF BODY WITH CEMENT, PETTMAN, TYPE A, SPEC, JAN-C-99 AND SECURE FIN ADAPTER WITH "O" RING IN POSITION TO ASSEMBLY WITH 180 IN-LBS. MINIMUM TORQUE.

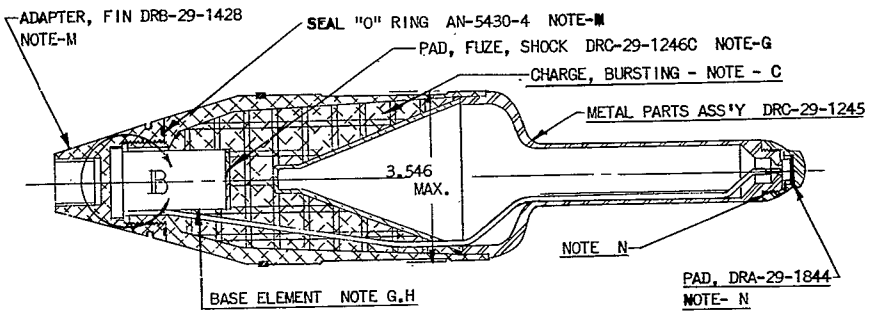
N. COAT SPIKE THREADS WITH PETTMAN CEMENT. PLACE PAD ON BATTERY UNIT AND SECURE NOSE, SPIKE, TO SPIKE WHILE SPIKE IS WET WITH 144 IN-LBS. MINIMUM TORQUE.

P. INSERT LOT NUMBER, MONTH AND YEAR LOADED. REQUIRED ONLY WHEN SHELL IS NOT FUTHER IDENTIFIED BY SEGREGATION.

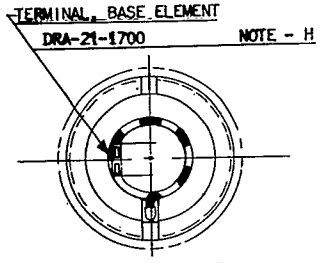
R. MARK WITH YELLOW NO. 3305 STENCIL INK.



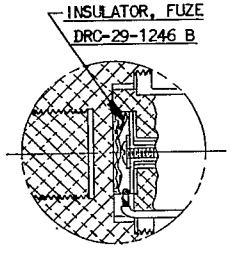
PAINTING AND MARKING DIAGRAM



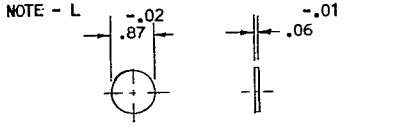
SHELL LOADING ASSEMBLY DRC-29-1246 A



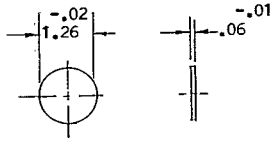
END VIEW OF BASE ELEMENT
ADAPTER, FIN REMOVED TO SHOW WIRING



VIEW B



INSULATOR, FUZE DRC-29-1246 B
FELT, PRESS No 10½



PAD, FUZE, SHOCK DRC-29-1246 C
FELT, PRESSED, No 10½

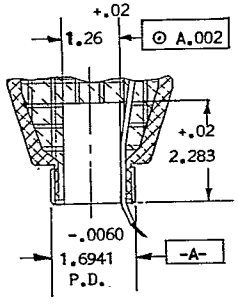
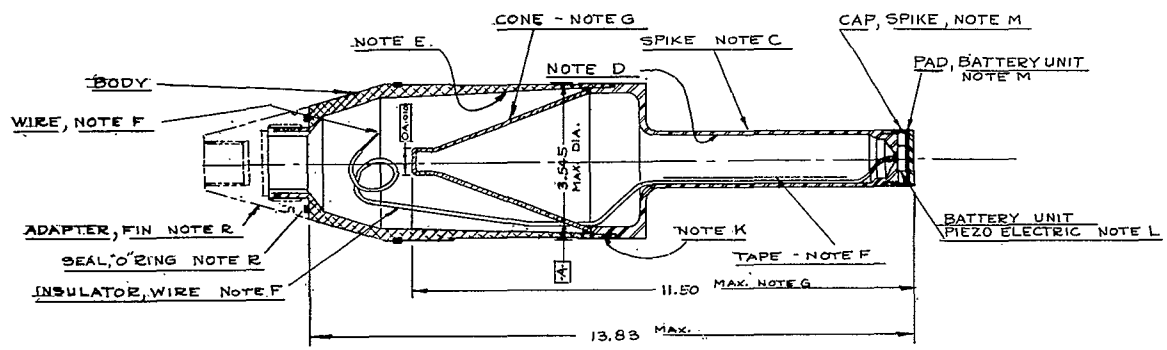
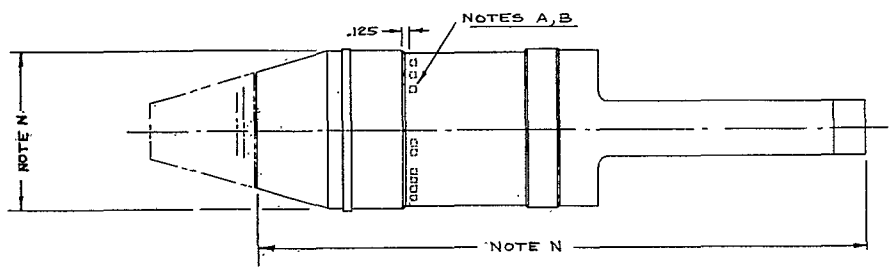


Fig. 10. Shell, HEAT, 90 mm., T249E8 Mod. 2 Loading Assembly.
Firestone Dwg. No. DRC-29-1246.

CONFIDENTIAL



METAL PARTS ASSEMBLY



PAINTING & MARKING DIAGRAM

LINE No	NAME OF PART	No. REQ'D PER COMPONT	PIECE MARK
1	ADAPTER, FIN	1	DRB-29-1428
2			
3			
4	BATTERY UNIT ASS'Y	1	75-2-502-F2
5	BODY	1	DRC-29-1235
6			
7	CONE	1	DRB-29-1430
8			
9	INSULATOR	1	DRA-14-1627 1-8
10			
11	CAP, SPIKE	1	DRA-29-1840
12			
13	PAD, BATTERY UNIT	1	DRA-29-1852
14			
15			
16			
17	SEAL "O" RING	1	AN-5430-4
18	SPIKE	1	DRC-29-1240
19	TAPE	1	DRA-29-1851
20	TERMINAL, BASE EL.	1	DRA-21-1700
21			
22	WIRE	1	DRA-29-1848

NOTES:
A. STAMP "90MM T249E8 Mod. 2B" AND PROJECTILE SERIAL NUMBER.
B. LETTERS AND FIGURES TO BE .125 HIGH AND .01 DEEP.
C. PREPARE OR CLEAN ALL SURFACES OF SPIKE IN ACCORDANCE WITH GRADE 1 SPEC. PA-PD-191 BEFORE PAINTING.
D. COAT INTERIOR SURFACE OF SPIKE, EXCEPT CONE SEAT, WITH GREEN NO. 3412 ENAMEL BEFORE ASSEMBLY WITH BODY.
E. COAT INTERIOR SURFACE OF BODY EXCEPT PART TO BE CEMENTED UNDER NOTE K, WITH ACID PROOF BLACK PAINT, TYPE 1 OR 2 BEFORE ASSEMBLY.
F. THREAD FUZE WIRE THRU INSULATOR AND CEMENT TO SPIKE USING TAPE AND RUBBER CEMENT, TYPE 3, SPEC. MIL-C-5092
G. APPLY CEMENT, TYPE 3, TO CONE SEAT OF SPIKE, INSERT INSULATOR AND WIRE IN HOLE IN CONE, AND CRIMP FLANGE OF SPIKE OVER CONE 360°.
H. APPLY CEMENT, TYPE 3, TO JUNCTION OF INSULATOR AND CONE
K. CEMENT SPIKE INTO BODY IN ACCORDANCE WITH PROCEDURE ON DRAWING DRA-10-1530.
L. CRIMP BATTERY UNIT TO FUZE WIRE AND SEAT BATTERY UNIT IN POSITION ON SPIKE.
M. PLACE PAD, BATTERY UNIT, ON BATTERY UNIT AND SECURE CAP, SPIKE, TO SPIKE HAND TIGHT. DO NOT CEMENT THREADS.
N. COAT EXTERIOR SURFACES OF METAL PARTS EXCEPT THREADS WITH GREEN NO. 3412 ENAMEL, SPEC. MIL-E-10687
R. THESE PARTS TO BE SHIPPED SEPARATELY BY MANUFACTURER.

Fig. 11. Shell, HEAT, 90 mm., T249E8 Mod. 2B Metal Parts Assembly.
Firestone Dwg. No. DRC-29-1250.

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NOTES:

A. RETOUCH EXTERIOR SURFACES OF SHELL WHERE PREVIOUS COATING HAS BEEN DAMAGED WITH GREEN ENAMEL NO. 3412.

B. GUIDE WIRE AND WIRE INSULATOR THRU SLOT IN REAR OF BODY AND INSERT POURING RISER.

C. POUR COMP. B.

D. REMOVE POURING RISER AFTER COMP. B. HAS HARDENED.

E. FACE OFF COMP. B. TO DEPTH SHOWN.

F. X-RAY ASSEMBLY TO DETECT POSSIBLE DETRIMENTAL CAVITATION IN COMP. B. CAST.

G. PLACE FUZE WIRE AND WIRE INSULATOR IN SLOT OF BODY. PLACE BASE ELEMENT SHOCK PAD DRC-29-1251 C IN BASE ELEMENT CAVITY. THE BASE ELEMENT INSULATION RESISTANCE MUST BE MEASURED AND RECORDED. PLACE BASE ELEMENT IN CAVITY.

H. CUT WIRE AND INSULATOR 1.5 INCHES BEYOND BASE ELEMENT. BARE WIRE A DISTANCE OF 3/16 INCH FROM END. CRIMP SOLDERLESS TERMINAL TO BARED SECTION. REMOVE POST. ATTACH TERMINAL TO POST AND SCREW POST TO BASE ELEMENT.

K. PERFORM FINAL ELECTRICAL TESTS.

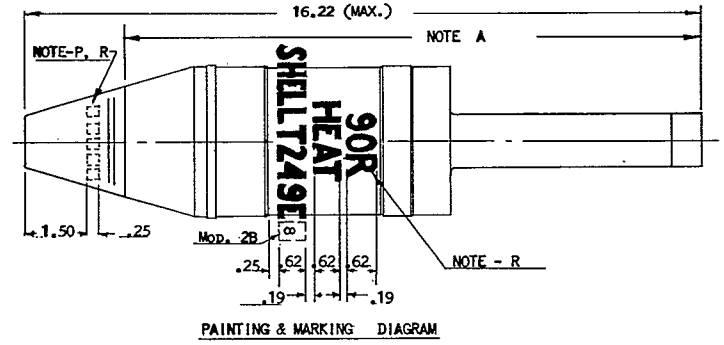
L. PLACE INSULATOR, FUZE, DRC-29-1251 B ON BASE ELEMENT.

M. COAT REAR THREADS OF BODY WITH CEMENT, PETTMAN, TYPE A, SPEC. JAN-C-99 AND SECURE FIN, ADAPTER WITH "O" RING IN POSITION TO ASSEMBLY WITH 180 IN-LBS. MINIMUN TORQUE.

N. COAT SPIKE THREADS WITH PETTMAN CEMENT. PLACE PAD ON BATTERY UNIT AND SECURE CAP, SPIKE, TO SPIKE WHILE SPIKE IS WET WITH 144 IN-LBS. MINIMUM TORQUE.

P. INSERT LOT NUMBER, MONTH AND YEAR LOADED. REQUIRED ONLY WHEN SHELL IS NOT FURTHER IDENTIFIED BY SEGREGATION.

R. MARK WITH YELLOW NO. 3305 STENCIL INK.



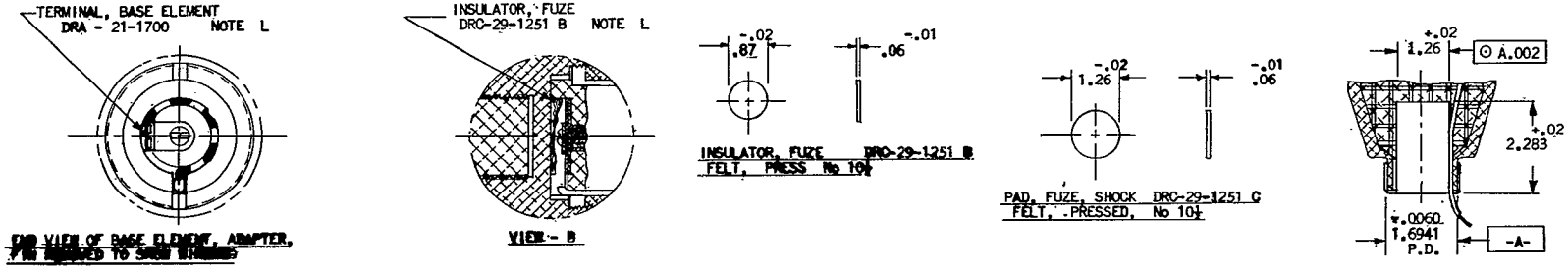


Fig. 12. Shell, HEAT, 90 mm., T249E8 Mod. 2B Loading Assembly.
Firestone Dwg. No. DRC-29-1251.

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Prior to the receipt of the above propellant, test cartridges fired at Erie Ordnance Depot will contain propelling charges of propellants available at that installation.

Propellant Container

An interim Mylar propellant container design has been selected. The container drawing (DRC29-1257) is reproduced in Fig. 13. The propellant loading assembly (DRB29-1443) is shown in Fig. 14.

One hundred and fifty containers have been ordered and a partial delivery of 29 has been accepted. The remainder will be delivered early in April. Ninety-five containers will be shipped to Ravenna Arsenal and the remaining 55 to Erie Ordnance Depot.

Cartridge Containers

The detail and assembly drawings of the interim shipping container which will accomodate three T249E8 type cartridges are shown in Figs. 15 and 16, respectively. This design represents the Picatinny Arsenal design with an increase in length. Fifty containers have been ordered. This number will provide packaging for T249 E8 Mod 1 and Mod 2 cartridges.

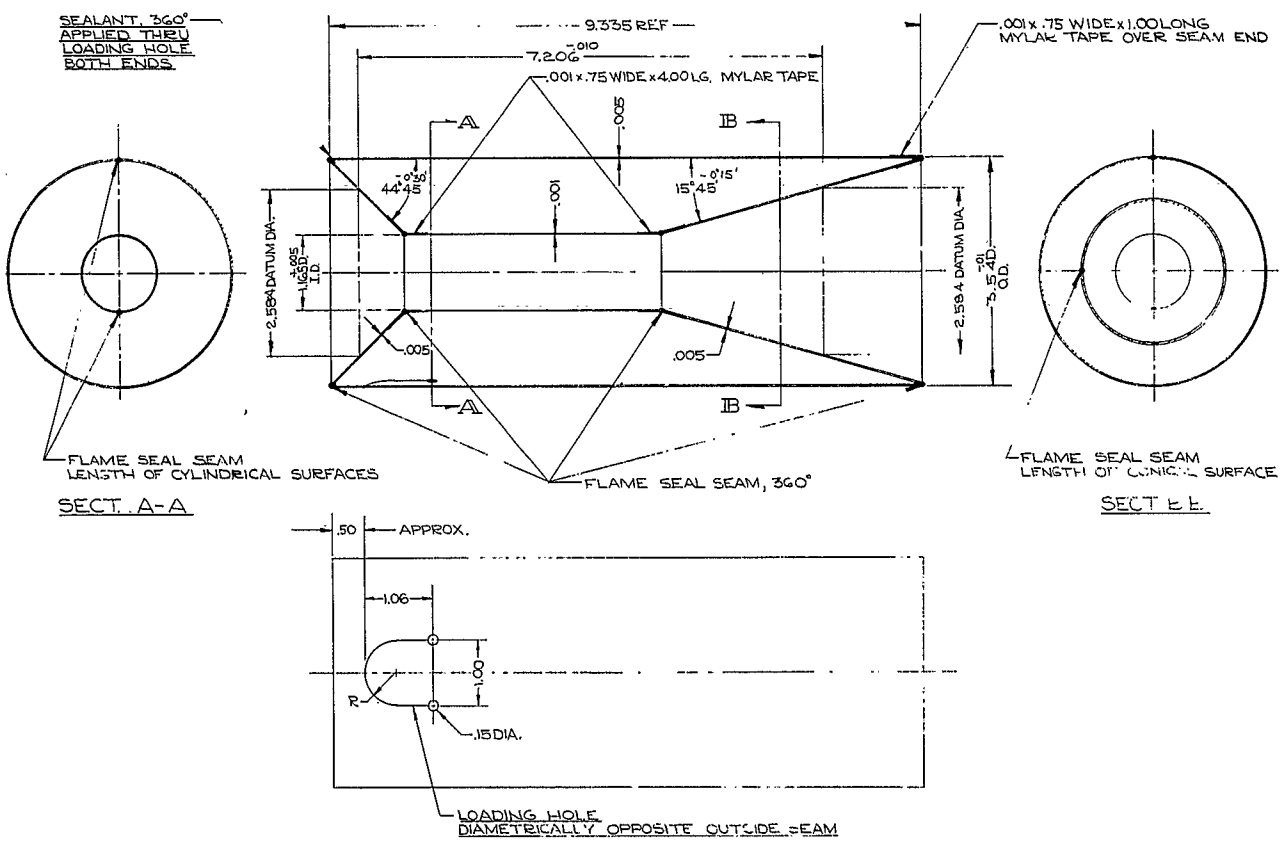


Fig. 13. Mylar Propellant Container.
Firestone Dwg. No. DRC-29-1257.

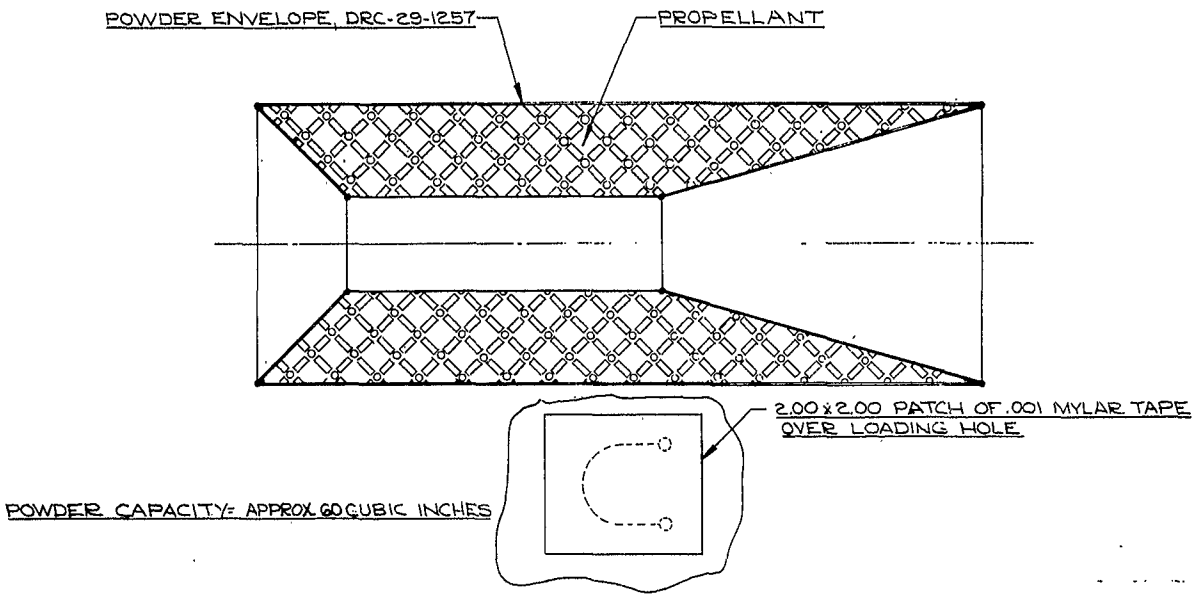


Fig. 14. Propellant Loading Assembly.
Firestone Dwg. No. DRB-29-1443.

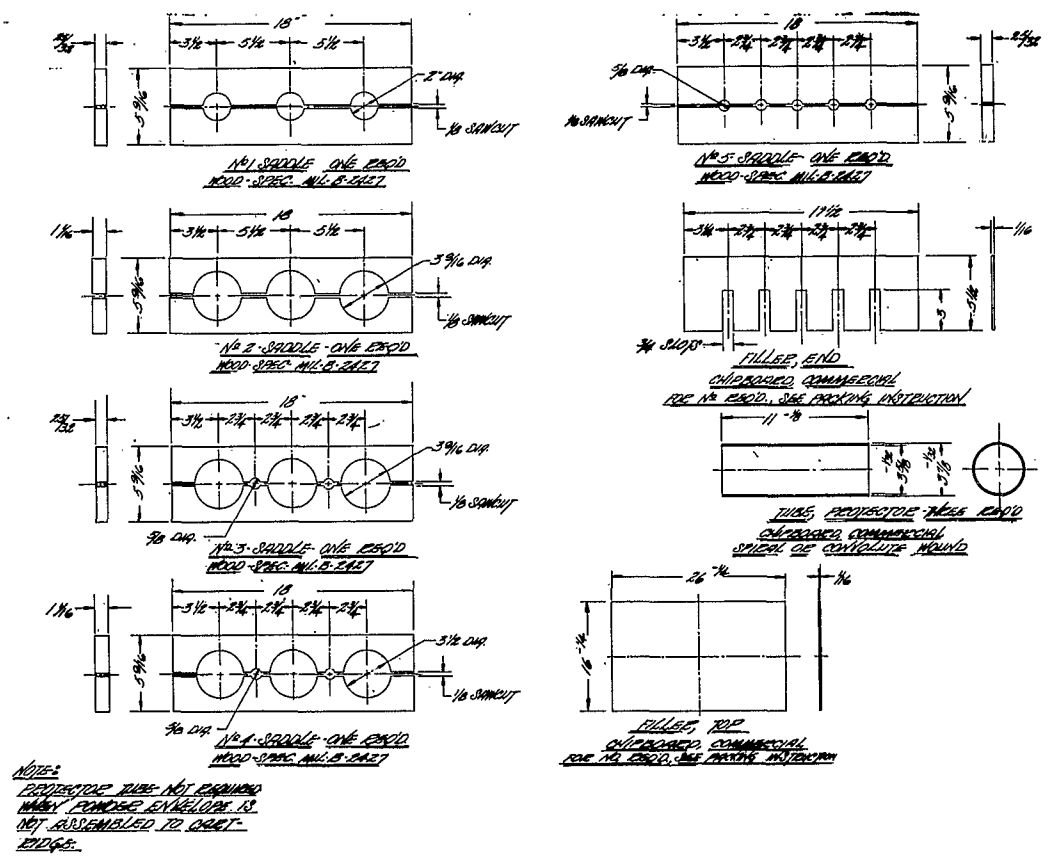
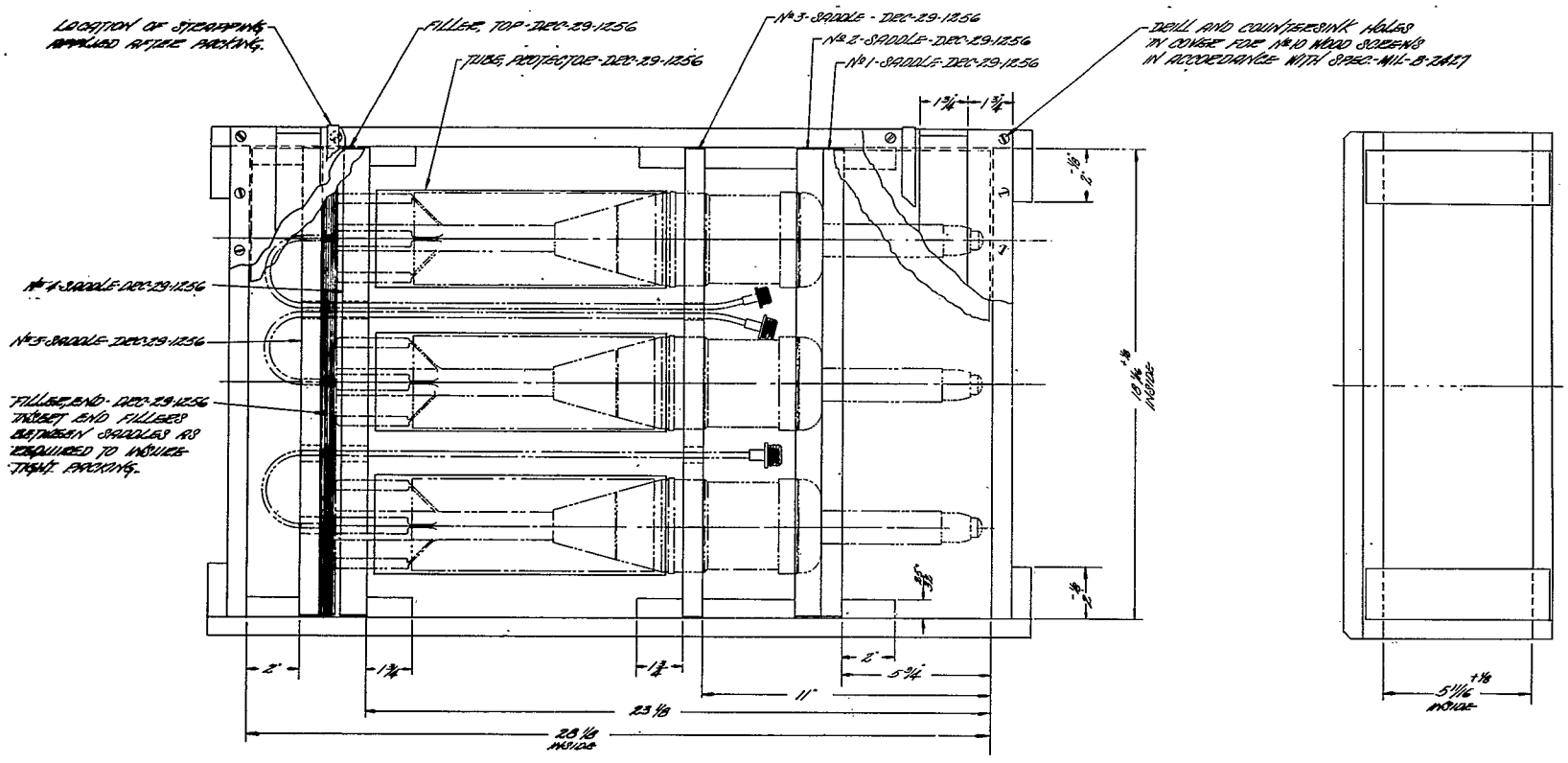


Fig. 15. Detail Drawing for Cartridge Container.
Firestone Dwg. No. DRC-29-1256.



MARKING INSTRUCTIONS

THE BOX SHALL BE MARKED IN ACCORDANCE WITH DRAWING 20-4-613. THE DESCRIPTIVE NOMENCLATURE, CALIBER AND WEAPON DESIGNATION SHALL BE: "CARTRIDGES 90 MM HEAT TRACER W/FUZE ELECTRIC FOR RIFLE T23A". THE "CC" NOMENCLATURE TO BE APPLIED, WHEN PROJECTOR ENVELOPE IS ASSEMBLED TO CARTRIDGE, SHALL BE "AMMUNITION FOR CANNON AND EXPLOSIVE PROJECTILES". THE "CC" NOMENCLATURE TO BE APPLIED, WHEN PROJECTOR ENVELOPE IS NOT ASSEMBLED TO CARTRIDGE, SHALL BE "EXPLOSIVE PROJECTILES". THE CUBICAL DISPLACEMENT SHALL BE: - 2.9"

PACKING INSTRUCTIONS

PACK THREE CARTRIDGES AS SHOWN. ADD END FILLERS BETWEEN №4 AND №5 SADDLES AS REQUIRED TO ADVANCE SPIKE OF CARTRIDGE UNTIL IT CONTACTS №1 SADDLE. PLACE TOP FILLERS ON TOP OF SADDLES AS REQUIRED TO INSURE TIGHT PACKING. FITTINGS COVER BOX WITH №10 WOOD SCREWS. REINFORCE BOX WITH ⅝ X .02 THICK, CLASS 'A' OR 'C' SPECIFICATION QQ-S-781 STEEL STRAPS AS SHOWN.

SECURITY

THE MATERIALS PACKED UNDER THESE INSTRUCTIONS HAVE BEEN CLASSIFIED IN ACCORDANCE WITH AR 380-5, PARAGRAPH 29, AND SHALL BE HANDLED, STORED AND SHIPPED ACCORDINGLY.

NOTE:
1-MATERIAL AND CONSTRUCTION SHALL BE IN ACCORDANCE WITH SPEC. GRADE 'B'; TYPE-I, STYLE-4, SPEC. MIL-B-2427, 25/32 LUMBER

Fig. 16. Assembly Drawing for Cartridge Container.
Firestone Dwg. No. DRD-29-771.

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PAT RIFLES

The manufacture of the test rifle has been completed during the report period. The rifle was shipped to the Erie Ordnance Depot on March 15. Proof acceptance and recoil balancing tests will be conducted when the test cartridges have been assembled and loaded. A picture of the test rifle is shown in Fig. 17. Inspection data for the test rifle will be reported in a future progress report.

Manufacture of the 90mm T234 prototype recoilless rifle has begun. The rifle is 50% completed. Frankford Arsenal will supply the prototype venturi and finalized drawings for the venturi sleeve and spring. Completion of the rifle in April, as scheduled, is contingent upon the receipt of the above items.

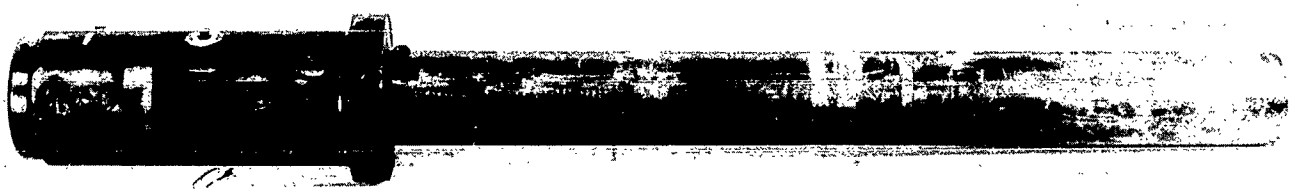


Fig. 17. The Test Rifle.

Future Program

1. Perform shaped charge evaluation tests.

2. Evaluate performances of primers and propellant containers.

3. Expedite delivery of Mod 2A and Mod 2B spike noses, dummy base elements, propellant containers and shipping containers.

4. Conduct fuze evaluation tests using five T249E8 Mod 1 projectiles.

5. Prepare 95 T249E8 Mod 1 cartridges for shipment as directed by Frankford Arsenal.

6. Perform comparative tests of T249 E8 Mod 2A and Mod 2B projectiles.

7. Manufacture 900 T249E8 type projectiles.

8. Assemble 26 test cartridges for rifle interior ballistic evaluations.

9. Proof test rifle.

10. Manufacture prototype rifle.

11. Proof prototype rifle.

T119 PROJECTILE
105 MM. FOLDING FIN BAT

Obturation and Spin Study

It has been demonstrated by tests described in previous reports that improving the obturation of the T119E11 (M344) projectile gives improved accuracy. The best accuracy results were obtained with a gilding metal obturator from a smooth bore tube. Some tests were fired with slip nylon obturators from a rifled tube; and the accuracies obtained, though good, were not as good as those obtained with the gilding metal obturator. Fastax pictures of the muzzle blast show the gilding metal band to give better obturation than the nylon band, and the better obturation appears to be associated with better accuracy.

Test results for T119E11 type projectiles with gilding metal or with nylon bands are reported in the Thirty-Fourth, Forty-Third, Forty-Fourth, Forty-Ninth, Fiftieth, Fifty-Fourth and Fifty-Seventh Progress Reports.

The gilding metal obturator requires a special smooth bore tube. It was felt that the nylon band could be developed to give better obturation, and this band could be fired from the standard M40 rifled tube. Previous designs with nylon band required a special body. A quantity of M344 components was obtained, and by a simple modification the existing body was grooved to accept a nylon band. Details of the body modification are shown in Figure 18. The fins were shortened by cutting two inches from the tip and one fin of each projectile was marked with a .04 in. dia. by .5 in. pin for yaw card spin measurements. The modified M344 projectiles were inert loaded and designated T119E16 (DRD755).

To evaluate the obturation and spin qualities of nylon bands having different outside diameters, 14 T119E16 projectiles were assembled as shown in Table IV. The rounds were fired through a series of five yaw cards. Fastax pictures were taken of nearly all rounds.

Table V gives the range data for this program and Table VI a summary of the results including a comment on the quality of obturation based on study of the Fastax

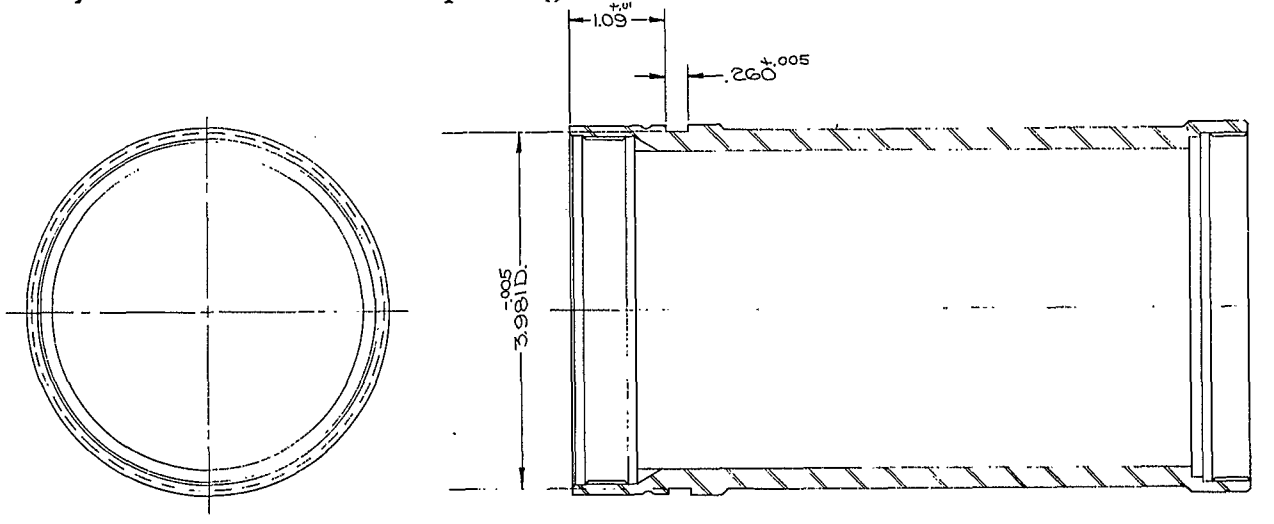
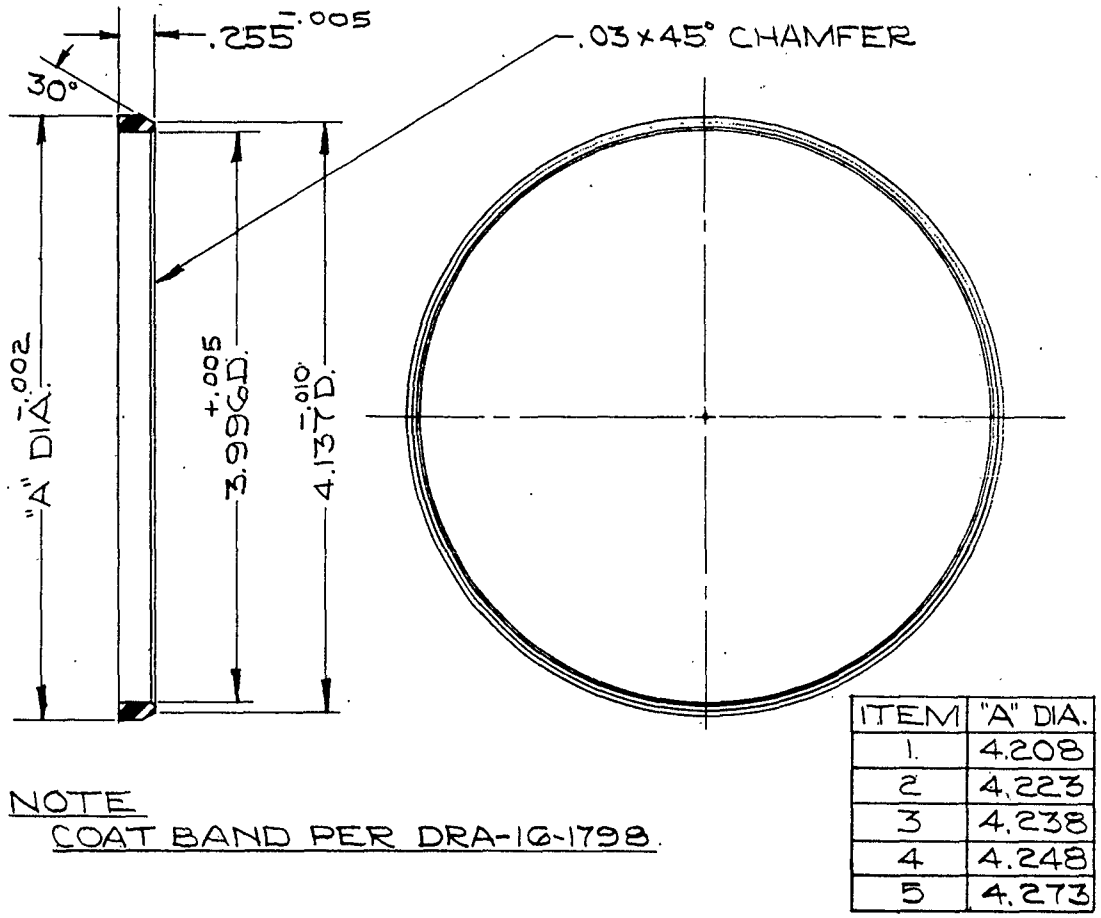


Fig. 18. Modified Body—106 mm., M344.
Firestone Dwg. No. DRB-14-1412.

Table IV
Assembly Data

No. of Proj's.	Band Drawing Numbers	Band O.D. (in.)
5	DRA-14-1834 Item 2*	4.223
4	DRA-14-1834 Item 3*	4.238
5	DRA-14-1834 Item 4*	4.248

* See Fig. 19.



ITEM	"A" DIA.
1.	4.208
2	4.223
3	4.238
4	4.248
5	4.273

Fig. 19. Obturating Band.
Firestone Dwg. No. DRA-14-1834.

pictures. Figs. 20 and 21 are muzzle blast photographs of the 4.238 in. and 4.248 in. equipped rounds, respectively.

From the spin data, a plot of roll angle vs range was made for each round, and the slope of this curve determined. This was taken as the average roll rate (degrees per foot) and used in calculating an average spin rate. This spin rate is tabulated in Table VI appearing immediately below the tabulated spin values; it is not an average of the values preceding it in the column, but agrees closely with the average.

Table V
Range Data
Obturation and Spin Test
With T119E16 Projectiles

Date of Test 1-2 FEBRUARY 1956
Location ERIE ORDNANCE DEPOT

Purpose of Test OBTURATION AND SPIN OF T119E16
Program No. 373

PROJECTILE
Model T119
Type E16 (ORD 7555)
Weight 17.2 LBS.
C.G. Location –
Bourrelet Dia. 4.128 -0.002 IN.
Retard. Factor 0.195 FT/SEC/FT.
Special Features NYLON BAND (DRA-14-1834)

TEST GUN
Model T170E1
Type 106 MM RECOILLESS
Serial No. 56
Chamber B-4360-5
Bushing (Vent) CLX-102-7 F-23
Tube B-4131-5 (B-4360-5) 1/20 TWIST
Sighting Equip. BORESIGHT CASE
Mount:
Type PENDULUM Ser. No. OLD
Constant 2.04 LB-SEC/IN.
Firing Mech. ELECTRIC WITH CAP

MISCELLANEOUS DATA
Range DOWN
Propellant:
Type MP M10 Web PAE 9929 PAE 9931 Weight AS SHOWN
Lot No. LS 13-26
Primer M57
Shell Case T53E1
Liner T4E1
Temperatures: °F.
Magazine 79 75 75 1 FEB.
Max. 79 Min. 76 Present 77 2 FEB.
Loading Room 76 Ambient 32 2 FEB.

Round Number	Proj. Number	Proj. Weight (lb.)	Propell. Weight (lb.–oz.)	Chamber Pressure (psi) (Cu. Inches) (Internal M3)	Muzzle Velocity (fps) Instr.	Muzzle Velocity (fps) Actual	Band Item	Elevation (mils) zero	Elevation (mils) super	Position of Hit (inches) Vert.	Position of Hit (inches) Horiz.	Corrected Posit. of Hit – (mils) Vert.	Corrected Posit. of Hit – (mils) Horiz.	Rear Recoil (in.)	Fastax 8mm	Observations
1 FEBRUARY 1956			PAE 9929 PAE 9931													To simulate a .035 in. web, a composite propellant charge was used.
10790	2635	17.18	5-8 2-7	11,700 12,000	1691	1707	2							8¼	YES	The major portion, located at the base of the case, was PAE 9929, .030 in. web; the minor portion, located nearest the case mouth, was
10791	2636	17.16	5-5 2-7	11,300 10,900	1676	1692	2							10	YES	
10792	2637	17.16	5-5 2-7	11,200 10,900	1656	1672	2							7¼	YES	PAE 9931, .038 in. web.
2 FEBRUARY 1956																
10793	2638	17.12	5-3 2-7	10,400 10,700	1656	1672	2							6¾	YES	
10794	2639	17.12	5-3 2-7	11,000 10,700	1634	1649	2							5¼	YES	
10795	2640	17.06	5-3 2-7	10,900 10,900	1659	1675	4							5	YES	
10796	2641	17.14	5-3 2-7	11,100 10,900	1660	1676	4							½	YES	
10797	2642	17.26	5-3 2-7	11,200 10,900	1644	1660	4							½	YES	
10798	2643	17.20	5-3 2-7	10,900 11,200	1666	1682	4							4¾	NO	
10799	2644	17.26	5-3 2-7	10,700 10,900	1657	1673	4							6¾	NO	
10800	2645	17.18	5-3 2-7	10,400 10,600	1633	1649	3							4	YES	
10801	2646	17.08	5-3 2-7	10,700 — *	1651	1667	3							3¼	YES	
10802	2648	17.26	5-3 2-7	10,500 10,600	1647	1663	3							5¾	YES	
10803	2649	17.12	5-3 2-7	10,300 10,800	1654	1670	3							7¼	YES	
																Type lubricant: M77 on band seat; M88 on band.

Muzzle | 41.03' / 41.03' | 1 | 81.80' / 81.98' | 2 | 1 FEBRUARY 1956 / 2 FEBRUARY 1956
Screen (Coil) Distances

Muzzle | 9.68' / 10.32' | 1 | 7.24' / 6.89' | 2 | 11.85' / 11.52' | 3 | 5.02' / 5.36' | 4 | 16.68' / 16.41' | 5 | – / – | 6 | 1 FEBRUARY 1956 / 2 FEBRUARY 1956
Distances (Yaw Cards) (Spin Screen)

*Unreasonable Reading.

Proof Director E.F. HUFFMAN Program Director R.E. VANGELOFF
Observers F.S. MENDEZ

CONFIDENTIAL

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Table VI
Spin Data
T119E16 Projectile With Different Diameter Nylon Bands

Round No.	Card No.	ϕ (deg.)	$\Delta\phi$ (deg.)	ΔZ (ft.)	$\frac{\Delta\phi \text{ deg.}}{\Delta Z\ \Delta Z}$	Velocity (fps)	Spin (rps)	Obturation Comment
Band Number 2 - O.D. = 4.223 In.								
10790	1	264.0				1707		Fair
	2	278.0	14.0	7.26	1.93		9.2	
	3	302.5	24.5	11.85	2.07		9.8	
	4	314.0	11.5	5.02	2.29		10.8	
	5	353.5	39.5	16.68	2.37		11.2	
							10.3 (a)	
10791	1	49.5				1692		Poor
	2	62.0	12.5	7.26	1.72		8.1	
	3	85.5	23.5	11.85	1.98		9.3	
	4	98.5	13.0	5.02	2.59		12.2	
	5	137.5	39.0	16.68	2.34		11.0	
							10.1 (a)	
10792	1	-----				1672		Poor
	2	137.0	----	7.26	----		---	
	3	168.0	31.0	11.85	2.62		12.2	
	4	184.0	16.0	5.02	3.19		14.8	
	5	233.5	49.5	16.68	2.97		13.8	
							13.3 (a)	
10793	1	68.0				1672		Poor
	2	85.5	17.5	6.88	2.54		11.8	
	3	115.5	30.0	11.57	2.59		12.0	
	4	129.5	14.0	5.35	2.62		12.2	
	5	175.0	45.5	16.41	2.77		12.9	
							12.4 (a)	
10794	1	357.5				1649		Poor
	2	15.0	17.5	6.88	2.54		11.6	
	3	42.0	27.0	11.57	2.33		10.7	
	4	55.5	13.5	5.35	2.52		11.5	
	5	99.5	44.0	16.41	2.68		12.3	
							11.6 (a)	
Band Number 4 - O.D. = 4.238 In.								
10795	1	304.0				1675		Good
	2	324.0	20.0	6.88	2.91		13.5	
	3	355.0	31.0	11.57	2.68		12.5	
	4	10.0	15.0	5.35	2.80		13.0	
	5	60.5	50.5	16.41	3.08		14.3	
							13.5 (a)	
10796	1	251.0				1676		Good
	2	272.5	21.5	6.88	3.12		14.5	
	3	306.5	34.0	11.57	2.94		13.7	
	4	321.5	15.0	5.35	2.80		13.0	
	5	21.0	59.5	16.41	3.62		16.9	
							15.0 (a)	
10797	1	268.5				1660		Event obscured on Fastax pictures
	2	290.0	21.5	6.88	3.12		14.4	
	3	323.5	33.5	11.57	2.90		13.4	
	4	340.5	17.0	5.35	3.18		14.7	
	5	394.0	53.5	16.41	3.26		15.0	
							14.3 (a)	
10798	1	341.0				1682		No picture
	2	5.0	24.0	6.88	3.49		16.3	
	3	43.0	38.0	11.57	3.28		15.3	
	4	62.5	19.5	5.35	3.64		17.0	
	5	121.0	58.5	16.41	3.56		16.6	
							16.2 (a)	
Band Number 3 - O.D. = 4.248 In.								
10799	1	227.5				1673		No picture
	2	248.0	20.5	6.88	2.98		13.8	
	3	284.0	36.0	11.57	3.11		14.4	
	4	301.5	17.5	5.35	3.27		15.2	
	5	359.0	57.5	16.41	3.50		16.3	
							15.2 (a)	
10800	1	100.0				1649		Event obscured on Fastax pictures
	2	120.5	20.5	6.88	2.98		13.6	
	3	150.0	29.5	11.57	2.55		11.7	
	4	167.0	17.0	5.35	3.18		14.6	
	5	221.5	54.5	16.41	3.32		15.2	
							13.9 (a)	
10801	1	280.0				1667		Good
	2	296.0	16.0	6.88	2.32		10.7	
	3	323.0	27.0	11.57	2.33		10.8	
	4	336.5	13.5	5.35	2.52		11.7	
	5	20.0	43.5	16.41	2.65		12.3	
							11.4 (a)	
10802	1	260.0				1663		Good
	2	274.5	14.5	6.88	2.11		9.7	
	3	301.5	27.0	11.57	2.33		10.8	
	4	315.0	13.5	5.35	2.52		11.6	
	5	357.0	42.0	16.41	2.56		11.8	
							11.1 (a)	
10803	1	-----				1670		Good
	2	168.5	----	6.88	----		----	
	3	194.5	26.0	11.57	2.25		10.4	
	4	209.0	14.5	5.35	2.71		12.6	
	5	250.0	41.0	16.41	2.50		11.6	
							11.3 (a)	

Note:
(a) From slope of line through plotted values.

It appears that the smallest band of the three tested (4.233 in. O.D.) is not large enough to provide good obturation; both others appear adequate. All spin rates were under 20 rps and are, therefore, considered acceptable. Small values of the infrequent yaw indicate good launchin characteristics.

Additional rounds will be fired to deter mine if a larger band diameter gives im proved obturation at an acceptable spi level.

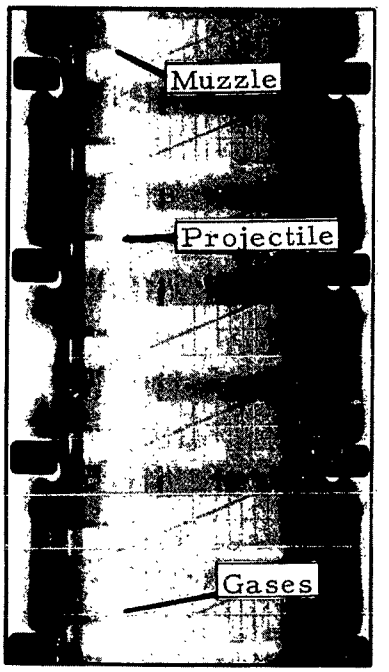


Fig. 20. Muzzle Blast Photographs.
Round Using 4.238-In. Band.

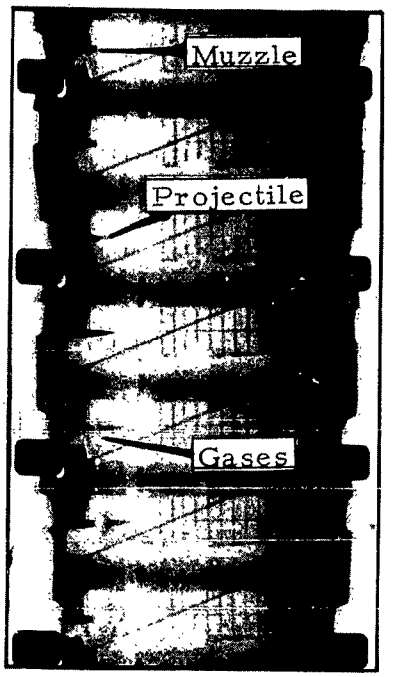


Fig. 21. Muzzle Blast Photographs.
Round Using 4.248-In. Band.

T335 PROJECTILE
90 MM. FOLDING FIN BAT

Nine T335E11 projectiles (spike nose) have been fired at the 2000-yard target. Firing was discontinued because of high winds. The remaining rounds will be held for more favorable weather.

Future Program

1. Eleven T335E11 projectiles (spike nose) are being held for the most favorable weather for 2000-yard accuracy test.

2. Twenty T335E12 projectiles (3-cal. ogive) are being assembled. These projectiles will be fired for accuracy at a range of 2000 yards to compare their accuracy with that of the spike-nose T335 E11 projectiles.

3. Additional nylon band designs will be tested for improved obturation. Four slugs are available for these tests.

PENETRATION STUDIES

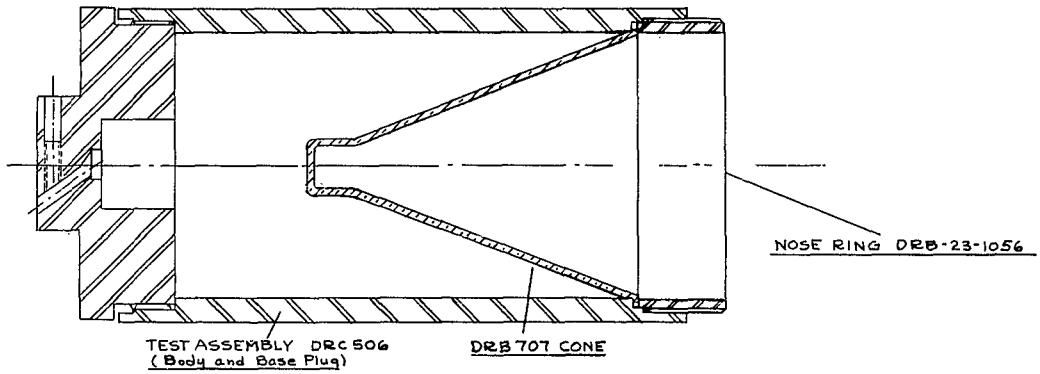
PAT PENETRATION STUDIES

Effect Of Ogive And Nose Assembly

The penetration tests to determine the effect of ogive ALX-178-6 and nose assembly ALX-178-9 on penetration have been completed.

The tests were conducted with test assemblies DRC506 equipped with cones DRB707 and ogives and nose assemblies which duplicate the corresponding parts of shell T249E8. The three items compared were test assembly DRC506 and nose rings DRB-23-1056, test assembly DRC506 with ogive DRA-29-1842, and test assembly DRC506 with ogive DRA-29-1842 and nose assembly LX 178-8, -9 and -15. The data are presented in Tables VII, VIII and IX. The assemblies tested are shown at the top of each table.

Table VII
Penetration Data
Test Item 1 (Control)



Serial No.	Standoff (in.)	Rotation (rps)	Penetration (in.-M.S.)	Max. Spread (in.)	Std. Dev. (in.)
K52	7.25	0	18.12		
K53	7.25	0	17.44		
K54	7.25	0	17.18		
K55	7.25	0	16.44		
K56	7.25	0	18.31	1.75	.54
Ave.	7.25	0	17.50		

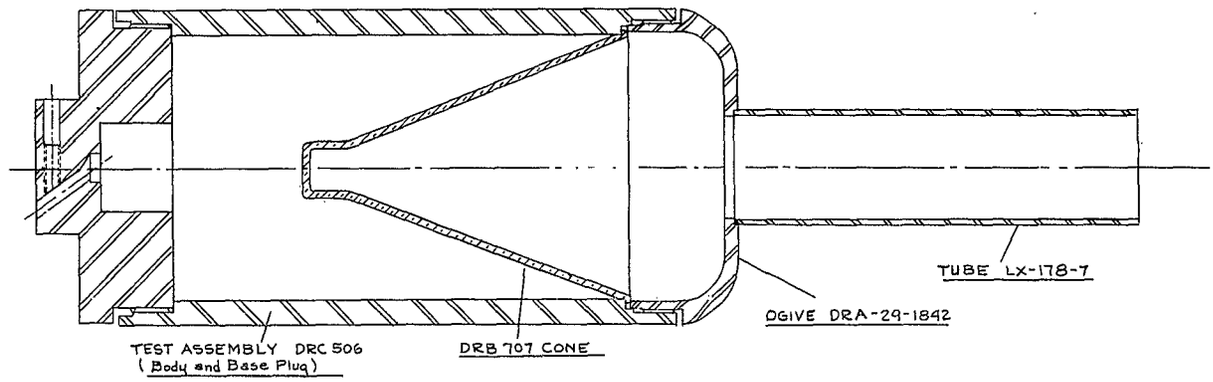
Notes:
1. DRB707 cones are machined from drawn DRB398 cones. Machine cut taken inside and outside.
2. All assemblies were loaded at Ravenna Arsenal, Comp. B, Lot No. 85 from Holston Lot 4-1197.
3. All tests were performed at Erie Ordnance Depot.

The DRB707 cones used in this test were made from DRB398 cold drawn cones that were available from stock. A light skin cut was made on the inside of the cone and then the cone was finish machined to dimension. The cone is shown in Fig. 22. The cone inspection data are summarized in Table X. The loading data are shown in Table XI. The results of the test are summarized in Table XII. From these data the following conclusions are derived:

(1) The ogive alone produces only a slight reduction in penetration i.e. (. 5 inch).

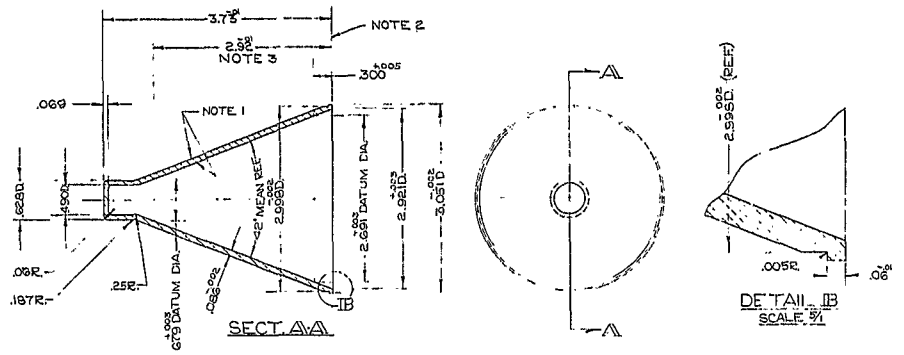
(2) The ogive and nose assembly combined produce a reduction of 1. 6 in. The nose assembly apparently produces 1. 2 in. of the total reduction in penetration produced by the entire ogive and nose assembly.

Table VIII
Penetration Data
Test Item 2



Serial No.	Standoff (in.)	Rotation (rps)	Penetration (in.-M.S.)	Max. Spread (in.)	Std. Dev. (in.)
K37	Ogive + 1 9/16	0	16. 31		
K41	Ogive + 1 9/16	0	17. 50		
K44	Ogive + 1 9/16	0	17. 81		
K45	Ogive + 1 9/16	0	16. 44		
K46	Ogive + 1 9/16	0	17. 19	1. 50	. 65
Ave.	Ogive + 1 9/16	0	17. 05		
K38	Ogive + 1 9/16	18	16. 31		
K39	Ogive + 1 9/16	18	15. 87		
K40	Ogive + 1 9/16	18	15. 44		
K42	Ogive + 1 9/16	18	16. 94		
K43	Ogive + 1 9/16	18	16. 75	1. 50	. 62
Ave.	Ogive + 1 9/16	18	16. 26		

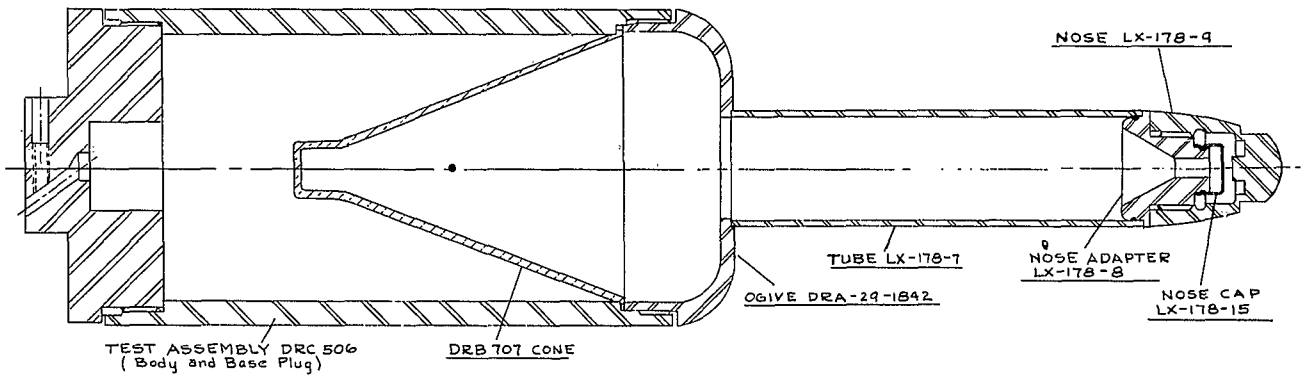
Notes:
1. DRB707 cones are machined from drawn DRB398 cones. Machine cut taken inside and outside.
2. All assemblies were loaded at Ravenna Arsenal, Comp. B, Lot No. 85 from Holston Lot 4-1197.
3. All tests were performed at Erie Ordnance Depot.



NOTE:
1. ALL INDICATED SURFACES TO BE CONCENTRIC WITHIN .003 T.I.R. WITH RESPECT TO 2.998 DIA. REGISTER.
2. INDICATED SURFACE TO BE PERPENDICULAR TO ℄ OF PART WITHIN .003 T.I.R.
3. IN THIS REGION VARIATION IN STRAIGHTNESS OR THICKNESS OF WALL SHALL NOT EXCEED .003 IN ANY AXIAL PLANE; WALL THICKNESS IN ANY TRANSVERSE PLANE SHALL NOT EXCEED .001 VARIATION.
4. FINISH 63.
5.
6. THIS CONE MAY BE MADE BY MODIFYING CONE DRB-398.

Fig. 22. 90 mm., 42-degree Cone.
Firestone Dwg. No. DRB-707-1.

Table IX
Penetration Data
Test Item 3



Serial No.	Standoff (in.)	Rotation (rps)	Penetration (in.-M.S.)	Max. Spread (in.)	Std. Dev. (in.)
K47	Ogive & Nose	0	15.37		
K48	Ogive & Nose	0	15.44		
K49	Ogive & Nose	0	16.06		
K50	Ogive & Nose	0	16.00		
K51	Ogive & Nose	0	16.44	1.06	.45
Ave.	Ogive & Nose	0	15.86		

Notes:
1. DRB707 cones are machined from drawn DRB398 cones. Machine cut taken inside and outside.
2. All assemblies were loaded at Ravenna Arsenal, Comp. B, Lot No. 85 from Holston Lot 4-1197.
3. All tests were performed at Erie Ordnance Depot.

Table X
Summary Inspection Data
Cone DRB707

Drawing Number DRB707-1	Wall Thickness (in.)	Max. Wall Thickness Variation (in.)		Max. Wall Waviness (inch)		Concentricity - T.I.R. (in.)		
		Transv.	Longitud.	O. D.	I. D.	Base Datum	Apex Datum	Cone Tip in Assembly
Specification	Max. .086 Min. .084	.001	.003	.003	.003	.003	.003	.015
Maximum	.087	.004	.006	.002	.001	.011	.013	.015
Minimum	.078	.000	.001	.001	.001	.002	.002	.004
Average	.0840	.0019	.0029	.0011	.001	.0048	.0069	.0080
Std. Dev.	.0019	.0012	.0015	.0002	.0000	.0026	.0034	.0029

Table XI
Loading Data
DRC506 Body; DRB707-1 Cone

Round No.	X-Ray No.	Proj. Loaded Wt. (lbs.)	Empty Proj. Wt. (lbs.)	H.E. Wt. (lbs.)
K37	A1	7.60	6.00	1.60
K38	A2	7.64	6.04	1.60
K39	A3	7.60	6.02	1.58
K40	A4	7.58	6.00	1.58
K41	A5	7.58	5.95	1.60
K42	A6	7.62	6.02	1.60
K43	A7	7.58	6.00	1.58
K44	A8	7.58	5.98	1.60
K45	A9	7.62	6.02	1.60
K46	A10	7.58	6.00	1.58
K47	A11	7.88	6.30	1.58
K48	A12	7.88	6.30	1.58
K49	A13	7.90	6.30	1.60
K50	A14	7.88	6.30	1.58
K51	A15	7.86	6.28	1.58
K52	A16	6.90	5.32	1.58
K53	A17	6.90	5.30	1.60
K54	A18	6.90	5.34	1.56
K55	A19	6.90	5.30	1.60
K56	A20	6.88	5.30	1.58

Notes:

1. All X-ray results were satisfactory.
2. Comp. B temperature 186°; projectile temperature 76°; cool room temperature 76°; cooling time 50 min.
3. Date loaded March 6, 1956.

Table XII
Summary Penetration Data
Types 1, 2 and 3

Type	Standoff (in.)	Rotation (rps)	Penetration (in. - M.S.)	Max. Spread (in.)	Std. Dev. (in.)
1 (Control)	7.25	0	17.5	1.75	.54
2	7.25 (Ogive + 1 9/16)	0	17.05	1.50	.65
2	7.25 (Ogive + 1 9/16)	18	16.26	1.50	.62
3	7.25 (Ogive + Nose Assembly)	0	15.86	1.06	.45

(3) Eighteen rps, which is the spin rate expected at 900 fps, reduces the penetration by approximately 3/4 in.

On the basis of an 80% homogeneous armor to mild steel conversion factor, and neglecting the difference between static and dynamic penetration, the test assembly should produce about 12.5 in. penetration into homogeneous armor. This figure is tested against homogeneous armor.

BAT PENETRATION STUDIES

No penetration testing was conducted on BAT programs during the month of March.

Thirty 120mm test assemblies were made and delivered to Ravenna Arsenal for Comp B loading.

FUTURE PROGRAM

PAT Projects

Test I. Evaluation of new ogive and nose assembly

If it is shown that the ogive and nose assembly do reduce the penetration, fire five test assemblies DRC 506 with cones DRB707 equipped with an ogive and nose assembly patterned after that of the T300 shell.

Test II. Selection of Cone

1. Cone to configuration of 5th stage draw of Eastern Tool drawing process (Sixty-Fourth Progress Report). This cone to have .086 in. to .090 in. wall,

effective diameter 3.3 in. Cone to be manufactured by draw process with a final coining operation for dimensional control. To be tested in T249E8 Mod. 2 body (Al). To be tested at 0 and 20 rps at built in standoff.

2. Cone to the same configuration as item1, manufactured by shear forming for optimum performance at 15 - 20 rps.

To be tested in T249E8 Mod. 2 body (Al) at 0, 15, 30 and 45 rps with 5 samples taken at each spin rate to establish optimum spin rate and 5 samples to be fired at optimum spin rate.

3. Double angle, uniform wall thickness cones. This cone will be similar to DRB-16-1418 except the effective diameter will be approximately 3.3 in. in diameter, and the flange detail will be changed. These cones will be shear formed and annealed. To be tested in T249E8 Mod. 2 (Al) bodies at 0 and 20 rps at built in standoff.

4. Double angle, tapered wall cones. This cone will be similar to DRB1171 except that the effective diameter will be increased and the flange detail changed. These cones will be manufactured by shear forming with an anneal.

To be tested in the T249E8 body (Al) at 0 and 22 rps at built in standoff.

5. Single angle, 42^{o} apex angle cones manufactured by shear forming and annealing. These cones will be similar to DRB707 except that the effective diameter will be increased to approximately 3.3 in. and the flange detail changed (DRB-29-1429). To be used as controls. To be tested in the T249E8 (Al) body at 0 and 20 rps and built in standoff.

BAT Projects

120mm Studies

A group of 30 shear formed 120mm cones have been manufactured and are being assembled into test assemblies for H.E. loading. These assemblies will be fired at various standoff distances to determine the comparative penetration effect.

TERMINAL BALLISTIC EFFECTIVENESS

BAT PROJECTS

Future Program

1. Program 2 phase II (Test Program No. 320) of the present lethality program is in progress at Aberdeen Proving Ground. The program outlined in the Fiftieth Progress Report has been augmented to contain 125 shell; 75 shell M344 and 50 shell M344 modified by replacing the DRB398 cone with the DRC-23-916 Breidenbach sleeve type cones. Ten of the latter have the aluminum sleeve cemented to the basic copper cone and are crimped together. The test firing and fragment dispersion beyond the target counting will be continued to completion of the program.

2. The six groups of assemblies manufactured for the terminal ballistic (lethality) test to be conducted jointly by Frankford Arsenal (Pitman-Dunn Laboratories), Aberdeen Proving Ground (Ballistic Research Laboratory and Development Proof Services) and Firestone to assist the joint committee on BAT weapons in the selection of a caliber for continued development of the Ultimate BAT weapon are currently being tested. The six groups of shell are:

(1) Shell, HEAT, T336E21, 120mm (Frankford Arsenal)
(2) Shell, HEAT, M344, 106mm (Control)
(3) Shell, HEAT, T194E4, 105mm (Firestone)
(4) Shell, HEAT, T335E8, 90mm (Firestone)
(5) Shell, HEAT, M344, Modified to have flanged cone.
(6) Shell, HEAT, M344, modified to have Zamak cones.

The static penetration, dynamic penetration and ballistic lethality firings have been completed. Data reduction for these tests is in process. The fuel ignition tests are in process. The firings against tanks has not commenced. However, it is reported that tanks have been made available for this test.

ENGINEERING AND SHOP HOURS

The following statement of hours expended is presented as required by paragraph (C, 1, d) under REPORTS, page 3, of Contract DA-33-019-ORD-2037. "A statement of the approximate number of (1) engineering and (2) shop hours expended in accomplishing the work performed during the report period".

(1) Approximate number of Engineering Hours

March, 1956	2000

(2) Approximate number of Shop Hours

March, 1956	2950

DESTRUCTION OF TECHNICAL REPORTS

In accordance with letter dated 30 August 1954 from the Office, Chief of Ordnance (00/4U0-35696), the following policy has been established:

a. All Ordnance Corps Research and Development technical reports should be destroyed when no longer required for reference by the recipient.

b. Destruction of classified technical reports should be in accordance with AR 380-5.

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